Annals of Nutrition and Metabolism

Opening Lecture

OL1:

Serendipities of Acquired Immunity.

Tasuku Honjo[1]

1.Kyoto University, Nobel Prize laureate in Physiology or Medicine in 2018 (Japan)

In 1992, we started working on PD-1 and found that this acts as a brake in the immune system. Then, in 2002, we discovered that PD-1 inhibition could be effective in treating cancer in animal models. After 22 years of study, this idea has borne fruit in a new, breakthrough immunotherapy that is being hailed as a 'penicillin moment' in cancer treatment. I believe that, just as a number of antibiotics developed in the wake of the discovery of penicillin now protect humans against threats of infectious diseases, this discovery will play a leading role in advancement of cancer immunotherapy so that in the future the fear of dying from cancer will cease to exist. Through evolution, vertebrate animals have developed immunity against infection by microorganisms. In the process, they incidentally acquired a sophisticated system for diversifying genomic information by combining gene fragments. It was doubly fortunate that the success in cancer treatment via PD-1 inhibition brought the realization that immunity, a “weapon” against infectious diseases, could also serve as a “shield” against cancer. It has been said that, whereas humankind's greatest enemies in the 20th century were infectious diseases, cancer is the major foe in the 21st century. It is a pleasant surprise to discover that the acquired immunity system holds the keys to overcoming both of these difficult medical challenges.

Keyword: PD-1, cancer immunotherapy

Conflict of Interest Disclosure: Research founding Meiji Holdings Co., Ltd., Meiji Seika Pharma Co., Ltd., Shimadzu Corporation

CL1:

Personalized, Population and Planetary Nutrition: A Health world.

J. Alfredo Martinez[1,2,3]

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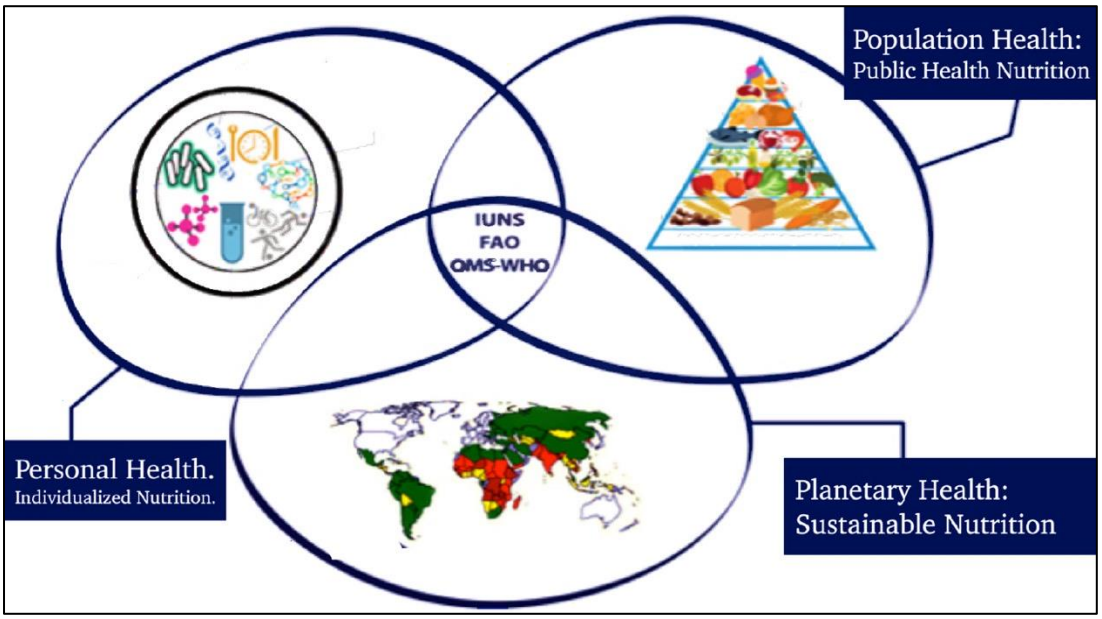
Nutrition is a global science that originally analyzed and integrated those processes transforming food components contributing to body homeostasis to ensure life and wellbeing, nowadays nutritional interests are additionally being focused on mankind wellness involving physical, emotional, intellectual, civical, spiritual, environmental and occupational facets. Moreover, according to the emerging health settings, food intake should be screened concerning social, satisfactory, secure, safe and sustainable expressions, while that global updated public health and precision nutrition arms should be planetary harmonized, emphasizing on personalized participative, preventive and predictive directions in order to maintain health as well as to prevent and manage diseases at global level (Figure 1).



Precision nutrition not only consider individual´s genomic backgrounds, but also phenotypically related traits including family and personal clinical features, perinatal feeding information and a wide spectrum of data concerning metabolic pathways. Indeed, the conceptual framework describing precision nutrition is based on evaluating the inter-personal diversity caused by genetic/epigenetic differences, the environmental and lifestyle exposome heterogeneity, metagenomic variations in microbiota, and objective behavioral/psychological features with evident consequences for conjoint personal and population public health-related precision challenges and applications.

A number of endeavors and efforts are being currently devoted to generate evidence for health promotion and disease risk reduction based on food-based dietary guidelines (FBDG) in order to instruct population about healthy dietary habits. Interestingly, nutritional advises in different regions seem to be similar across countries such as to consume a variety of foods; fruits and vegetables, legumes with controlled animal-source foods; and to limit high calorie diets, sugar, fat, and salt intakes. Information sourced from the FBDG repository of the FAO or WHO reveals that FBDG are currently available for about 100 countries, where the incorporation of environmental sustainability information, climate change data and considerations to sustainability sociocultural factors and swiftly varying dietary tendencies are being slowly incorporated. Epidemiological investigations concerning the impacts of Japanese, Nordic and Mediterranean diets or plant-based nutritional patterns on chronic diseases have evidenced remarkable benefits in health outcomes.

Nutrition improvement anywhere in the world is a societal, household and individual right. Indeed, a major focus of Planetary nutrition is to fight against the etiological roots and hazardous consequences on health concerning the double burden of malnutrition, which involve not only undernutrition, stunning , underweight and wasting, but also includes hidden deficiencies affecting micronutrients such as iron and Vitamin A, as well as excessive body weight and obesity, which are associated to a highly prevalent impact non-communicable diseases across the Globe These wellbeing endeavors should also assimilate concepts of sustainability, food security plus environmental climate change monitoring , which are receiving support and resources from important organizations and institutions such a UN agencies, FAO, IUNS, and specifically via the sustainable Development Goals Declaration *in* order to match the planetary needs for nutrients intake considering socio-economic and political concerns controlling food distribution, aided by capacity building and online learning strategies.

Keywords: Precision Nutrition, Planetary Nutrition, Food-based dietary guidelines, Environmental sustainability, Global Health

Reference: Martínez-González MA, Kim HS, Prakash V, Ramos-Lopez O, Zotor F, Martinez JA. Personalised, population and planetary nutrition for precision health. BMJ Nutr Prev Health. 2021 Jun 2;4(1):355-358. doi: 10.1136/bmjnph-2021-000235.

Acknowledgements: The IUNS task forces and Council Catherine Geissler, Hyun Sook Kim, Benjamin Caballero, Francis Zotor, Ali Dhansay, Teruo Miyazawa, Andrew Prentice, Lynnette Neufeld, J Alfredo Martinez, Helmut Heseker and Vish Prakash are gratefully recognized.

Conflict of Interest Disclosure: None

Further Collaborators: The IUNS task forces and Council Catherine Geissler, Hyun Sook Kim, Benjamin Caballero, Francis Zotor, Ali Dhansay, Teruo Miyazawa, Andrew Prentice, Lynnette Neufeld, J Alfredo Martinez, Helmut Heseker and Vish Prakash are gratefully recognized.

AL1:
Healthier food environments: experience and lessons from Chile and Latin-America

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Worldwide, obesity and nutrition-related chronic diseases have reached epidemic proportions. At a population level, prevention is the most effective way of addressing these conditions. Individual preventive actions have shown limited impact and thus, policies that aim to improve food environments (i.e., physical, economic and policy conditions that influence people's food behaviors) have been suggested as a more cost-effective alternative. Interventions such as sweetened-sugared beverages tax, food marketing restrictions, and school policies have been implemented in Latin-American countries with promising results. However, larger impacts might be achieved by interventions that address different aspects of the food environment at the same time. In 2016 Chile implemented the Food Labeling and Marketing Law considered the most comprehensive package of food environment policies implemented to date to promote healthier food environments. This law considers the use of a front-of-package warning message to signal unhealthy foods (i.e., foods or beverages with high content of calories, sugars, total fats, or sodium), comprehensive marketing restrictions of unhealthy foods to children, and promotion of healthier school environments by banning the selling, promotion, and distribution of unhealthy foods. In this talk we will present results of the impact of the regulation on the food environment; consumers perceptions, attitudes, and behaviors; and food industry responses, including discourse framing, food reformulation, and employment. We will also discuss the challenges; the lessons learned and provide some insight on future directions for the research in this area.

Keywords: Food Environment, Nutrition Policies, Chile.

Conflict of Interest Disclosure: I have no Conflict of Interest.

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Annals of Nutrition and Metabolism

Plenary Lectures

PL(T1)01
Human brown fat: A tissue preventive against obesity and metabolic diseases

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We are now facing a worldwide increase in obesity and associated metabolic disorders such as diabetes mellitus and cardiovascular diseases. As obesity is a result of prolonged imbalance between energy intake and energy expenditure (EE), it can be treated by reducing energy intake and/or increasing EE. For the latter, while increasing physical activity is usually recommended, but sustained change in physical activity is rather difficult to achieve in our daily life. Adaptive non-shivering thermogenesis (NST) is another component of daily EE. NST is defined as an increase in EE above baseline levels in response to various environmental changes including cold exposure and food intake. NST is associated with the activation of brown fat, a unique adipose tissue of which primary function is to dissipate energy in the form of heat. Although brown fat research has long been limited mostly to small rodents, the rediscovery of metabolically active brown fat using radionuclide imaging technique in adult humans has dramatically accelerated the translational studies on brown fat in health and diseases. Now there is lots of evidence to show that brown fat takes parts in the regulation of whole-body EE, body fatness, and systemic metabolism in humans. For example, brown fat is activated after acute cold exposure and/or meal intake, in parallel with increased EE. The amount and activity of brown fat are inversely correlated with body fatness and insulin resistance. Moreover, repeated cold exposure re-activates and recruits brown fat to increase EE, reduce body fat content and improve glucose tolerance. Although cold exposure is undoubtedly the most physiological and effective regimen to activate and recruit brown fat, it would be difficult and uncomfortable to increase human exposure to cold temperatures under well-controlled conditions with the presence of clothing and heating systems. The stimulatory effects of cold exposure are mediated through transient receptor potential (TRP) channels and the sympathetic nervous system (SNS). Most TRP members also function as chemesthetic receptors for various food ingredients, and indeed, agonists of TRP vanilloid 1 such as capsaicin and its analog capsinoids mimic the effects of cold exposure to decrease body fatness through the activation and recruitment of brown fat. The anti-obesity effect of other food ingredients including tea catechins may be attributable, at least in part, to the activation of the TRP-SNS-brown fat axis. Thus, brown fat is a promising target to treat obesity and related metabolic disorders. In this lecture, I summarize evidence for the thermogenic and metabolic effects of brown fat, particularly focusing on regimens activating and recruiting brown fat in humans.

Keyword: Brown fat, energy expenditure, food ingredients, non-shivering thermogenesis, obesity
Conflict of Interest Disclosure: none

PL(T2)01
Signaling Pathways Through Which Leucine and Glucose Act to Stimulate mRNA Translation.

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Amino acids are not only substrates for protein synthesis, but also act to regulate the process. For example, refeeding a protein-containing meal to a fasted animal, but not one lacking protein, stimulates protein synthesis in skeletal muscle. Similarly, consumption of a mixture of essential, i.e., indispensable, amino acids by a fasted person upregulates skeletal muscle protein synthesis. Interestingly, consumption of a mixture of branched-chain amino acids, or even leucine by itself, leads to upregulation of muscle protein synthesis to an extent similar to the effect of a complete mixture of amino acids. Leucine-induced upregulation of protein synthesis is mediated by the protein kinase mechanistic target of rapamycin (mTOR). When mTOR is present in a complex referred to as complex 1 (mTORC1), it phosphorylates key regulators of mRNA translation including eukaryotic initiation factor 4E (eIF4E) binding proteins (4EBP) 1 and 2 and the 70 kDa ribosomal protein S6 kinase (p70S6k). Phosphorylation of 4EBP1/4EBP2 and p70S6k by mTORC1 promotes the assembly of the active mRNA cap-binding complex consisting of eIF4A, eIF4E, and eIF4G that meditates cap-dependent mRNA translation. Thus, by upregulating mTORC1 activity leucine stimulates the translation of most mRNAs. Leucine activation of mTORC1 is mediated by a family of proteins referred to as Sestrins, as in cells lacking all three Sestrins mTORC1 is insensitive to leucine deprivation or readdition. The Sestrins act to inhibit mTORC1 by binding to a GTPase-activating protein complex referred to as GATOR2. Leucine binds directly to Sestrins 1 and 2 and promotes their dissociation from GATOR2, leading to activation of mTORC1. Leucine also acts to promote dephosphorylation of Sestrin2. Interestingly, mTORC1 activity in cells lacking the Sestrins is insensitive not only to changes in leucine availability but is also insensitive to glucose deprivation or readdition. However, unlike leucine, glucose does not promote dissociation of the Sestrin•GATOR2 complex or dephosphorylation of Sestrin2. Moreover, glucose does not appear to directly bind to the Sestrins. Instead, hexokinase 2 is required for glucose to activate

mTORC1. Thus, hexokinase 2, but not hexokinase 1, associates with the Sestrins in a glucose-dependent manner, and cells lacking hexokinase 2 are resistant to glucose-induced activation of mTORC1. Notably, the effect of glucose on mTORC1 appears to be independent of the AMP-activated protein kinase, AMPK, as glucose readdition to cells lacking either the Sestrins or hexokinase 2 downregulates AMPK activity but fails to activate mTORC1. Overall, the signaling pathways through which leucine and glucose regulate mTORC1 activity appear to converge at the Sestrins, but may deviate downstream of them.

Keywords: Branched-chain amino acids, Sestrin, mTOR, protein synthesis

Conflict of Interest Disclosure: None

Further Collaborators: Leonard S. Jefferson, Ph.D. Paul A. Roberson, Ph.D.

PL(T3)01
Nutrition through the life course and lifelong health

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While links between diet and health have long been recognised, innovative epidemiological investigations conducted in the 1990s, using retrospective (historical) cohorts, highlighted the need to take a lifecourse approach to understanding the importance of nutrition as an influence on lifelong health. These studies linked non-communicable diseases (NCDs), such as diabetes and cardiovascular disease, in older populations to early experience - specifically to differences in patterns of fetal and infant growth. The findings led to new thinking about the origins of these leading causes of morbidity and mortality, focusing mechanistic research on understanding the role of nutrition during critical periods in the lifecourse, as well as effects of accumulation of risk over the lifespan - also rapidly embedded in policy to recognise key life stages and the opportunity for early intervention. Over the intervening quarter of a century much has been achieved, extending research beyond NCD outcomes to other public health priorities, including obesity and ageing, and identifying how and why nutrition is important. This presentation provides an overview of that progress and considers some of the implications of this learning for dietary recommendations and the design, timing and aims of future strategies to promote lifelong health.

Keywords: lifecourse, nutrition, health, prevention

Conflict of Interest Disclosure: None

PL(T4)01
Nutrition Epidemiology-Methodology and its Future Aspects

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Early ecologic associations between dietary fat and risks of many cancers, and inverse associations between intakes of fruits and vegetables and risks of these cancers in retrospective case-control studies, were not supported in prospective cohort studies, raising questions about the validity of dietary questionnaires used in these cohorts. However, in validation studies using detailed assessments of intake and biomarkers of diet as comparisons, these questionnaires have been sufficiently sensitive to intakes of dietary fat, other nutrients, specific foods, and dietary patterns to detect the hypothesized associations. Also, important effects of dietary fat on risks of breast and other cancers have not been supported by large randomized trials. The early associations with fruits and vegetables in case-control studies appear to be due to recall and/or selection bias, but some consistent inverse associations have been seen in cohort studies for specific fruits and vegetables and specific subtypes of cancers, such as ER-negative breast cancer. Long latencies and diet during childhood have only been possible to examine recently, and the limited evidence suggests important associations. In contrast to cancer incidence, many consistent associations between dietary factors and risks of diabetes and cardiovascular disease have been documented, including specific types of fat, sources of carbohydrate, fruits and vegetables, and overall dietary patterns. These findings, many of which have been supported by short term randomized trials with intermediate risk factors as outcomes, may be more easily seen because of a close temporal relation between diet and disease incidence.

Biomarkers of diet can be useful in nutritional epidemiology, especially for aspects of diet that can otherwise difficult to assess, such as additives, contaminants, and effects of food processing. However, biomarkers will usually playa complementary role because they can be affected by factors other than diet, including absorption and metabolism, some of which may be genetically determined. Other technologies for dietary assessment, such as imaging of meals, have been of long-standing interest, but the validity of these methods relative to available methods remains to be documented. Even a perfect assessment of short term intake can be a weak measure of long term intake, and any method should be sufficient inexpensive and practical to be repeated over time in long term follow-up studies to capture changes in food availability and personal choices.

Because randomized trials are not feasible to evaluate most hypotheses relating aspects of diet to disease risk, observational studies will continue to play a key role. Going forward, dietary questionnaires are likely to remain the core method for dietary assessment, complemented with biomarkers of intake for specific aspects of diet and possibly by new technologies. Prospective studies including assessment of early life diets, long follow-up, and repeated measures of intake will be especially important. High levels of certainty can be obtained when

findings are consistent with short term randomized trials with intermediate outcomes or Mendelian randomization analyses.

Keywords: Diet, Nutrition, Methods, Epidemiology, Assessment.

PL(T5)01
Large-scale regulatory and fiscal policy for tackling obesity and creating healthier diets

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We are still at a nascent level in learning the best ways to promote a healthy diet. We have learned that exercise is not the answer and we must focus on improving global diets. We have also learned how deleterious ultraprocessed foods are on our health and require policies to reduce consumption. Also we have learned how difficult it is to institute effective public policies due to the interference of the food industry. Globally the diets of the impoverished are much poorer than those of higher-income subpopulations. In most major countries people with lower incomes and educations are more likely to be obese or overweight compared to higher-income or higher-education populations. In all cases we will focus on these large disparities in the policies we review.

Despite industry obstructions, at least 44 countries have instituted sugar-sweetened beverage taxes, and a growing number has introduced effective front-of-the-package warning labels to draw attention to foods high in energy density and added sugar, sodium, and saturated fats or trans fats. In addition, a few countries have banned marketing to children and are moving forward to restrict marketing unhealthy ultraprocessed foods and beverages to the entire population. We present and review evidence of the impacts of these policies on food purchases and diets at the population and subpopulation levels in key countries such as Mexico, South Africa, Chile and Brazil.

We go on to review some of the food industry forces in our midst and across the globe that are attempting to stop these public health nutrition policies. While many government officials, advocates, and politicians push for efforts to improve diets and food choices, the adverse actions of the food and beverage industries create delays. The industries could be part of the solution, but they rarely are. Most if not all of the policies the food industries promote are ineffective. Industry self-regulation and corporate responsibility do not work. At the same time, the industries contradict the broader literature and advance research they have funded to argue that proposed restrictive policies do not work and have adverse results. We present some of the key elements that can advance understanding of this topic and fill the gaps in our knowledge.

Keywords: taxation, front-of-the-package labeling (FOPL), marketing ban, industry obstruction

Conflict of Interest Disclosure: none

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Camila Corvalan and Marcela Reyes (Institute of Nutrition and food technology, University of Chile)

Kanen Hofman and Nick Stacey (University of Witswatersrand) and Rina Swart and Tamryn Frank (University of Western Cape), South Africa

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PL(T6)01
Prevention of cardiovascular disease focusing on nutrition and eating habits

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CVDs cause globally every year some 18 million and all noncommunicable disease (NCD) some 41 million deaths. The scientific evidence on their causal risk factors is very strong. Dietary factors are closely related to CVD risk and risks of NCDs as a whole. Global Burden of Disease (GBD) Study (2019) lists dietary risks as most important factor behind NCD deaths (responsible for over 11million annually). Among them the most important are high sodium, low whole grains, low fruit, low nuts and seeds, low vegetables, low omega 3, low fiber and low polyunsaturated fats. Based on this evidence numerous prevention strategies have been formulated, both internationally and within countries. After the UN Political Declaration (2011) WHO developed Global Action Plan with global behavioural targets, especially to reduce global sodium intake and to halt obesity increase, but also with broader nutrition indicators. These were in 2015 linked with the 2015 UN Global Development Goals. Prevention of CVDs and NCDs by influencing population nutrition calls for comprehensive strategies, of which the WHO Global Strategy on Diet and Physical activity in 2004 was a good basis. Although interventions on high risk individuals is important in reducing their risk, interventions targeting the populations a whole and their social and physical environments have the greatest public health potential. Such interventions include measures to change people's dietary habits through both broad health promotion and by changing food environments through political decisions. Providing health information to people is only the basis for changes in eating habits. It is important to give people specific advices and change skills and to try to provide social and environmental support. Policy interventions relate, among other things, to taxation, marketing, public procurements and agricultural policy. Now that the evidence on the role of several dietary factors and also on the effectiveness of many intervention measures is very strong, the big question is how to implement these measures. The big obstacle is the implementation gap, due to both inertia in lifestyle changes and to difficulties in needed policy changes. Successful health promotion to change population eating habits calls for health promotion with correct theory and good intensity. Policy decisions to change the food environment have a great potential, but are often not easy. There are many reasons for the resistance, like public costs, private interests with lobbying, other public consequences and often even public opinion. It is

good to remember that “no pain, no gain”! Understanding the process of political decision making is crucial for progress. It calls for different measures, preferably mobilizing public support and with innovative use of media. Many examples, like the North Karelia Project/Finland, show that big positive changes in population nutrition are possible with comprehensive, intensive and theory-based work, and can, indeed, lead to considerable reduction in CVD rates. Thus the potential for CVD/NCD prevention through changes in nutrition and other lifestyles in the population is great.

Keyword: nutrition, prevention, cardiovascular, policy
Conflict of Interest Disclosure: None

PL(T7)01
Functional foods in the near future for realization of the society toward healthy and powerful longevity

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In Japan as a super-aged country, the construction of a society for healthy longevity and improvement of quality of life (QOL) is of presenting importance. It is thus an inevitable theme is SDGs. Healthy is closely associated with maintenance of good QOL and its further improvement. These states are necessarily coming out from homeostatic bodily conditions. However, the state of pre-illness is expected to even normal people, preferably by proper food consumption. Recalling the case in about 30 years before, we know that Japan proposed the name of functional food and its concepts together with the commercialization of some functional food products. These have been globally accepted. The products as well as the concepts have actually contributed to the “food for health” science and industry. These states have targeted the so-called metabolic syndrome, as a report was publicized with a headline “Japan explores the boundary between food and medicine (*Nature*, 1993). Meanwhile, a Cabinet Project, SIP, “The Next Generation Agricultural and Fisheries Projects and Functional Food Products” (2014-2019; Represented by K. Abe, The University of Tokyo) was available. Closely relate states of pre-illness in this project were exemplified by gut-brain coordination, locomotive risk recovery, homeostatic risk avoidance, time-dependent nutrition and sports, as seen in spotlight on food science in Japan (*Nature*, 2017). In this context, research activities as well as coming into being which target stress reduction, mental normalization, proper feedings, full sleeping, memory-cognition normalization. Also, locomotion, frail and other bodily problems are included. These may be applicable even to health people and their some abnormality if any. With them as backgrounds, “pre-illness marker” has been interested in industries, ministries and academic regions. Particularly, Committee on “food and pre-illness marker” (2020-2025) as the JSPS University-Industry Research Cooperation Societally. These activities of the Committee will make it possible to innovate Japan as a world-top runner for healthy longevity in the next generation.

Keywords: functional foods, healthy longevity, homeostatic bodily conditions, SIP: Cross-ministerial Strategic Innovation Promotion Program, pre-illness marker

PL(T8)01
Prospects and challenges of cultured meat

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In the coming 30 years, the FAO anticipates that meat demand will rise by 70% due to the global population growth and increase in wealth of India, China, South America and Africa. To ensure food security and to diminish the environmental and animal welfare burden of current beef production, we envisioned an alternative by culturing meat from bovine muscle-specific stem cells. Since 2013, when we presented the first proof of concept, cultured meat has undergone exponential growth in funding, number of people working on it and number of startups trying to commercialise the technology. In December 2020, we have witnessed the first cell-cultured chicken being approved for consumption in Singapore. Undoubtedly, in the coming two years, we will see more small scale market introductions of cultured meat products. For serious scaling up however, important hurdles need to be taken, such as industrial cell and tissue production, making products cost-effective and resource-efficient, setting up a scalable supply chain of ingredients, generating consumer acceptance and regulatory approval for each regional market. Major advances have been made in all these areas in the last years. None of these hurdles is unpassable, but together they form an intense challenge, that can only be successfully addressed with the involvement of a large number of stakeholders in different industries. For instance, we have seen more than a dozen more startups that are starting to produce low-cost growth factors, necessary to replace serum. We are also seeing different approaches to cultured meat, ranging from recombinant meat proteins to tissue engineering of complex full thickness meat and all of that across various species. At the same time, advances are made in plant-based and single cell protein alternatives and it will be interesting how these alternative protein sources will develop in the market either by themselves of in various combinations. Nutrition-wise, cultured meat will has the potential to mimic conventional meat better that the other alternative protein sources. However, with that mimicry also comes the unhealthy components of meat, i.e. saturated fat and, although not entirely proven, heme-iron in myoglobin. Examples will be shown how this can be avoided. State of the art and intermediate future perspectives of cultured meat will be discussed. Cultured meat is a multifaceted technology that will provide insight into many fascinating biological, psychological, societal and economical questions. At the same time, we urgently need to find solutions for the upcoming surge in meat consumption.

Keyword: cultured meat, alternative proteins, health
Conflict of Interest Disclosure: Employee, co-founder and shareholder of Mosa Meat, B.V.

Annals of Nutrition and Metabolism

Special Lectures

SL(T1)1
Homeostatic versus hedonic control of carbohydrate selection -from studies of AMPK in the hypothalamus

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Food selection is influenced by food palatability, nutritional state, and social factors such as stress. However, the mechanism responsible for selection between a high-carbohydrate diet (HCD) and a high-fat diet (HFD) remains unknown. In rodents, fasting and glucose deprivation increase the intake of an HCD when they are presented with both an HFD and an HCD in two-diet choice experiments. This is associated with a rapid recovery of whole-body metabolism during refeeding of carbohydrates compared with that of fat in diets.

We recently found that activation of a subset of corticotropin-releasing hormone (CRH)–positive neurons in the rostral region of the paraventricular nucleus of the hypothalamus (PVH) is necessary to induce the selection of an HCD over an HFD in mice during refeeding after fasting. These neurons manifested activation of a metabolic sensor, AMP-activated protein kinase (AMPK) during food deprivation. Studies with DREADD technology and expression of constitutively active AMPK or shRNA for AMPK in PVH CRH neurons revealed that the activation of AMPK in CRH neurons of the PVH is necessary and sufficient for the selection of an HCD over an HFD during refeeding after fasting. Furthermore, the effect of AMPK is mediated by a neuron type of carnitine palmitoyltransferase 1, CPT1c. Activation of isolated AMPK-regulated CRH neurons by AMPK activator increased cytosolic calcium level in the neurons depending on their cellular AMPK and CPT1c levels. A single nuclear RNA analysis revealed that a subpopulation of PVH CRH neurons expresses AMPK catalytic subunits (alpha1 and 2) abundantly, compared with those in non-CRH neurons in the PVH. We also found that the CRH neurons are involved in HCD selection after social defeat stress. In contrast, diet-induced obese mice impaired AMPK activation in the PVH, increasing HFD selection during fasting.

Glucose deprivation by 2-deoxyglucose (2DG) increases carbohydrate as well as fat intake in rodents. In two-diet choice experiments in mice, systemic injection of 2DG first increased HCD selection and then increased HFD selection. Interestingly, suppression of PVH CRH neurons inhibited the HCD selection, while it increased the HFD selection. Total calorie intake did not change. The 2DG-induced HCD selection but not HFD selection was mediated by NPY neurons regulating PVH neurons.

Together, AMPK-regulated CRH neurons in the PVH regulate selection between carbohydrate and fat in diets. Our results identify the specific neuron in the hypothalamus and intracellular signaling pathway responsible for the regulation of the complex behavior of selection between carbohydrate and fat in diets. Given that mice prefer an HFD in two-diet choice experiments under a normal metabolic condition, AMPK-regulated CRH neurons in the PVH increase HCD selection overcoming a hedonic feeding for an HFD, dependent on a homeostatic need.

Keyword: food selection, CRH, AMPK, PVH, hypothalamus

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SL(T1)2
Chrono-nutrition

Shigenobu Shibata[1]

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Circadian clock systems play important roles in clock-related physiological functions including energy, protein, and mineral metabolisms. This clock system also has an important role in microbiota diversity, because impairment of circadian clock such as shift work caused not only obesity but also less diversity of fecal microflora. The increase in adiposity is related to significant changes in the human environment and lifestyle, including less physical exercise and high-energy dietary choices. This lifestyle is also related to locomotive syndrome, such as sarcopenia, osteoporosis, and joint problems. Thus, reducing fat and/or sucrose and increasing protein, minerals and dietary fibers in the diet and increasing physical exercise represent the primary methods for prevention of and/or recovery from lifestyle-related diseases such as obesity and locomotive syndrome especially in middle and old age persons. However, the best timing of nutrients/functional food intake is still unknown. After discovery of molecular mechanism of circadian rhythm, research field of chrono-biology has influenced on many other research fields such as pharmacology, nutrition science and sports /exercise science. Inulin rich breakfast compared to dinner reduced colon pH according with increase of short chain fatty acids and increased the diversity of fecal microflora in mice. In human experiments, artichoke powder (5g) was given at breakfast or

dinner. It is well known that blood glucose level by same meal is dependent on the meal time; glucose at dinner is higher than glucose at breakfast. Here, we monitored 24-hr interstitial glucose levels (GL) by freestyle libre Pro. Artichoke powder at breakfast in human experiments lowered the 24-hr GL, and lunch- and dinner-induced GL, as a "second meal effect". Artichoke intake at breakfast time improved the constipation, and increase of fecal *Bacteroidetes* and decrease of *Firmicutes* corresponding with reduction of GL in comparison to artichoke intake at dinner time. Thus, artichoke at breakfast has a good health effect on both small intestinal and large intestinal function. Cellobiose, water soluble dietary fiber and short chain fatty acids mixture food provided phase-resetting effects on mouse peripheral clocks. Protein rich food at breakfast increase the skeletal muscle volume in mice, and 10g milk protein intake at breakfast but not at dinner causes muscle volume and sarcopenia index marker increases in human intervention experiments. Web survey of the relationship of protein intake at 3 meal times and physical activity (Mets) demonstrated the strong positive relationship between protein volume/protein ration at breakfast and physical activity. These data suggest the importance of protein rich food at breakfast. Blood pressure is positively related to the ratio of Na/K at lunch, but not at breakfast and dinner, suggesting low intake K rich foods such as vegetable and fruits at lunch time. Blood pressure is negatively related the physical activity (Mets) at 18:00-21:00, but not other clock times. The present results strongly suggest that the timing of feeding and functional food is critical for protection of lifestyle related diseases. We are interested in elucidating how new approach such as chrono-nutrition and -exercise helps to promote health science using animal and observation/intervention human experiments.

Keyword: circadian clock, clock gene, food timing, life style related diseases

Conflict of Interest Disclosure: I have no conflict of interest disclosure.

SL(T1)3
Modulation of SREBPs activation, and functional food factors that prevent their activation

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SREBPs (SREBP-1 and SREBP-2) are membrane-bound transcription factors that control the transcription of lipogenic genes involved in the biosynthesis of fatty acids or cholesterol. These proteins interact with the dedicated associating protein SCAP and are primarily localized to the endoplasmic reticulum (ER). This complex forms a heterotrimeric with another ER membrane protein INSIG and remains on the ER membrane without transducing signals as a transcription factor in the nucleus. Under the sterol-depleted condition, the SREBP-SCAP complex detached from INSIG is transported from the ER to the Golgi apparatus where the N-terminal region, the active form of the transcription factor, is generated by sequential proteolysis by two types of cleavage enzymes, S1P and S2P. Finally, the active transcription factors translocated to the nucleus enhance the expression of target genes such as the LDL receptor. The C-terminal region of SCAP with the WD40 repeat, which contributes to the protein-protein association, interacts with the C-terminal region of either SREBP-1 or SREBP-2, despite they share only 49% amino acid homology. Based on this fact, we hypothesized that SCAP has unidentified associating proteins other than SREBPs, which may affect SREBP activation. To identify novel SCAP interacting proteins, the Flag-tagged C-terminal portion of SCAP was expressed in HEK293 cells and the interacting proteins were found by the immunoprecipitation (IP) method using anti-Flag antibodies. The mass spectrometry analyses revealed that heat shock protein 90 (Hsp90) is the most possible interacting protein of SCAP. Several types of IP experiments verified the formation of the HSP90-SCAP-SREBPs complex, thereby stabilizing SCAP and SREBPs, and elevating SREBP target gene expression. Overexpression of exogenous Hsp90 in HepG2 cells increased the intracellular triglyceride and cholesterol accumulation, whereas an Hsp90 inhibitor 17-AAG or Hsp90 knockdown reduced their accumulation. In the presence of 17-AAG, SCAP and SREBPs were rapidly degraded, which was hampered by a proteasome inhibitor, suggesting the involvement of the ubiquitin-proteasome pathway. When another type of Hsp 90 inhibitor was injected intraperitoneally into mice, the same effects observed in cultured cells were observed in the liver. Aiming at searching for food factors that mitigate SREBP activation, a luciferase assay system was established using the human fatty acid synthase (FAS) promoter. A stable human hepatoma cell line (Huh7) expressing the luciferase was cultured with various types of purified food factors (approximately 100 agents) to find out the potential candidates that suppress the FAS promoter activity. One of the potent suppressors was xanthohumol (XN), the most abundant prenylated flavonoid in hops. When wild-type Huh7 cells were cultured with XN, SREBP target gene expression was suppressed in a dose-dependent manner, thereby reducing fatty acid and cholesterol *de novo* synthesis. Western blot analyses revealed that XN inhibits proteolytic activation of SREBPs and that isoxanthohumol and 8-prenylnaringenin, XN derivatives, were less potent inhibitors. The detailed mechanism by which XN inhibits SREBP activation will be discussed in the talk.

Keyword: Cholesterol, SREBP, Functional food factor

SL(T1)4
Recent progress of research and evidence on Health Emergency and Disaster Risk Management (Health EDRM): call for global and interdisciplinary collaboration

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For the recent few decades, increasing number of natural disasters has been observed. Globalization, urbanization, health inequity, and global ageing have been affecting the increased

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

vulnerability and exacerbated the impact of emergencies and disasters. More recently COVID-19 pandemic and sporadic conflicts and other types of disasters also caused operational and implementation challenges for global societies.

The Sendai Framework for Disaster Risk Reduction 2015-2030, the resulting document of the 3rd UN World Congress for Disaster Risk Reduction, proposed strategic direction of global societies for disaster risk reduction with a paradigm shift from event-based to risk-based and human-centered approach. It highlights the imperative of health, and for the first time, health is clearly indicated as part of the objectives of disaster risk reduction. In line with this progress, WHO developed Health Emergency and Disaster Risk Management (Health EDRM) Framework in 2019, which support the Sendai Framework. Reliable scientific evidence is essential for effective policy and programs that support the implementation of these global frameworks and other regional, national, and local strategies and guidelines.

The 2016 WHO expert meeting on Health EDRM research identified fundamental gaps in knowledge and evidence, as well as the challenges in coordination and collaboration among stakeholders. WHO Thematic Platform for Health EDRM Research Network (Health EDRM RN), officially launched in 2018, is a global expert network supported by WHO HQ and Regional Offices, which aims to strengthen the scientific evidence on Health EDRM and to foster global collaboration among academia, government officials and other stakeholders for a harmonized approach to produce, disseminate and apply knowledge and evidence into policy and practice in regions and countries. The Health EDRM RN facilitated multiple global collaborative activities for the improvement of scientific evidence and knowledge dissemination, which includes the development of the WHO Guidance on Research Methods for Health EDRM and establishment of WHO Health EDRM Knowledge Hub. Along with the development and implementation of these global initiative, scientific evidence on Health EDRM has been also improved, as demonstrated by the series of publications of thematic special journal editions on Health EDRM (e.g. Special editions by Prof. Emily Chan for International Journal of Environmental Research and Public Health).

The 2022 Core Group Meeting of the Health EDRM emphasized the strong requirement for interdisciplinary collaboration, as well as further global, regional, national, and local knowledge dissemination to deliver the key evidence-base messages to be applied for better policies and programs.

As the co-chair of the Health EDRM RN, this special lecture will introduce the recent progress of scientific evidence on Health EDRM and related research areas linking with the development of multiple global initiatives on Health EDRM research. The lecture also highlight the latest research frontiers of Health EDRM and policy implications on disaster risk reduction in future extreme events.

Keyword: health emergency and disaster risk management, Health EDRM, interdisciplinary research, disaster risk reduction

SL(T2)1
Arginine as a functional amino acid in human nutrition and health

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As a functional amino acid, L-arginine serves not only as a building block of protein but also as a crucial substrate for the synthesis of nitric oxide (NO), creatine, polyamines, homoarginine, and agmatine in mammals (including humans). NO (a major vasodilator) increases blood flow to tissues. L-Arginine and its metabolites play important roles in metabolism and physiology. L-Arginine is required to maintain the urea cycle in the active state to detoxify ammonia. This amino acid also activates cellular mechanistic target of rapamycin (MTOR), focal adhesion kinase, and redox cell signaling pathways in mammals, thereby stimulating protein synthesis, inhibiting autophagy and proteolysis, enhancing cell migration and wound healing, promoting spermatogenesis and sperm quality, improving conceptus survival and growth, and augmenting the production of milk proteins. Although L-arginine is formed from glutamine/glutamate and proline in humans, these synthetic pathways do not provide sufficient L-arginine in infants or adults. Thus, humans and other animals do have dietary needs of L-arginine for optimal growth, development, lactation, fertility, immunity, and health. Much evidence shows that oral administration of L-arginine within the physiological range can confer health benefits to both men and women by increasing NO synthesis and thus blood flow in tissues (e.g., skeletal muscle and the corpora cavernosa of the penis). NO is a vasodilator, a neurotransmitter, a regulator of nutrient metabolism, and a killer of bacteria, fungi, parasites, and viruses [including coronaviruses, such as SARS-CoV and SARS-CoV-2 (the virus causing Covid-19)]. Thus, L-arginine supplementation can enhance immunity, anti-infectious and anti-oxidative responses, embryonic survival, fetal growth, wound healing, ammonia detoxification, nutrient digestion and absorption, lean tissue mass, and brown adipose tissue development; ameliorate metabolic syndromes (including dyslipidemia, obesity, diabetes, and hypertension); and treat individuals with erectile dysfunction, sickle cell disease, muscular dystrophy, and pre-eclampsia.

Keyword: L-arginine, blood flow, disease, health, metabolism
Conflict of Interest: Disclosure: none
Further Collaborators: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SL(T2)2
Sarcopenic obesity

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Obesity prevalence has reached epidemic proportions worldwide, posing unprecedented individual, social, and medical challenges, by increasing risk for metabolic diseases, chronic organ failures and cancer, as well as their acute complications. Reducing excess adiposity remains the fundamental treatment for obese individuals. However, complex metabolic and lifestyle abnormalities as well as weight reduction therapies per se may compromise the ability to preserve muscle function and mass. Indeed loss of skeletal muscle mass and function (sarcopenia) is common in individuals with obesity due to metabolic changes associated with sedentary lifestyle, adipose tissue derangements, comorbidities and the ageing process. Strong evidence indicates that low muscle mass and function have a major negative health impact in persons with obesity, leading to disabilities and increased morbidity and mortality. Awareness of the importance of skeletal muscle maintenance in obesity is however unfortunately still low among clinicians and researchers alike. The term 'sarcopenic obesity' has been introduced to identify obesity with low skeletal muscle mass and function, but its utilization is limited and consensus on its definition and diagnostic criteria has also been low. Knowledge on the prevalence of sarcopenic obesity in various clinical conditions and patient subgroups, on its clinical impact in patient risk stratification, and on effective prevention and treatment strategies remains therefore an unmet clinical priority. Optimal lifestyle approaches and potential nutritional care support strategies to preserve muscle mass in persons with obesity are particularly important, and optimization of body composition should become an additional key target in obesity treatment.

Keyword: Obesity, Sarcopenia
Conflict of Interest Disclosure: No conflict
Further Collaborators: No further collaborators

SL(T2)3
Eating behaviors as a future direction in nutrition research: what we have known and not known about the association between eating speed and obesity

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Health effects of ingredients and nutrients in foods have long been of main interest in nutrition researches, especially in nutritional epidemiology. This is based on the knowledge of nutritional biochemistry. In addition to this, nutritional physiology is also important determinant of our health. For example, in obesity, “percentage of energy taken from carbohydrate, fat, or protein” has long been paid a great attention. However, no matter which nutrient is taken for energy, “speed of taking energy” may affect to energy intake, and consequently to obesity status and to occurrence of some diseases. Self-reported rate of eating speed is probably the dietary factor that has ever shown the strongest association with body mass index in both sexes and across ages in many cross-sectional studies. The consistent association was shown in a meta-analysis. This association was shown also in prospective studies. In addition, self-reported rate of eating speed was statistically and positively associated with subsequent incidence of diabetes in a Japanese population. The question and the predefined answer is quite simple and well validated. Among the questions of dietary behaviors, this may be relatively rare and precious for studies. In this presentation, how eating behaviors is attractive as a future direction for human nutrition research is introduced and discussed by taking the association between eating speed and obesity as an example.

Keyword: nutritional epidemiology, obesity, eating behavior

SL(T2)04
Trends for cardiovascular disease in Japan, and its prevention through nutritional assessment and improvement

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In the 1960s, Japan had the highest mortality from stroke and the lowest mortality of ischemic heart disease (IHD) in the world. Since then, stroke mortality has decreased substantially and IHD mortality has declined moderately along with a large decline in blood pressure levels and for men a moderate decline in smoking albeit an increase in blood cholesterol levels. More recently, stroke mortality in Japan is still two-fold higher and IHD mortality is one-fourth compared with that in the US and UK. The large difference in cardiovascular disease profiles may be due to a material difference in profiles of cardiovascular risk factors, attributable to differences in diets. Higher sodium, lower calcium, and lower meat intakes, and for men higher alcohol consumption may have contributed to the higher prevalence of hypertension leading to a higher risk of stroke, while higher physical activity, higher n3 polyunsaturated fat (fish) intake, lower saturated fat (meat) intake contributed to the lower prevalence of obesity, diabetes, and dyslipidemia leading to a lower risk of ischemic heart disease. Albeit the moderate decline in IHD mortality, there has been an increasing trend for IHD incidence among urban middle-aged men (workers and residents) in Japan. This incidence trend is worth noting because of a potential future problem for public health and clinical practice. In such situations, the nutritional assessment is crucial to perform health counseling for nutritional improvements in the prevention of cardiovascular disease. The nutritional assessments are composed of 1) dietary assessment *per se*, i.e.,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

by different methods such as dietary records, 24-hour recall, and food frequency questionnaire, and 2) assessment of biomarkers such as blood lipids, fatty acids, protein, amino acids, vitamins, and inflammation markers. Japan is unique among the developed countries where IHD mortality has been low and continued to decline. However, careful surveillance is needed to examine whether the complex changes in lifestyles, i.e., lowering sodium and rice intakes, recent lowering fish intake and smoking while increasing animal protein and saturated fat intakes, and physical inactivity may affect the future trend in cardiovascular disease.

Keyword: Nutrition, Assessment, Improvement, Prevention, Cardiovascular disease

Conflict of Interest Disclosure: None

Further Collaborators: None

SL(T3)1
Health effects of dietary risks – evidence from the global burden of disease study

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Comparable evidence on disease-specific deaths, disabilities, and their causal risk factors is essential for policy-making and designing health interventions. The Global Burden of Disease (GBD) study is one of the largest systematic scientific efforts in the world: it provides a data-rich framework for comparing the importance of various diseases, injuries, and risk factors that cause death and disability over time and space. All estimated data are publicly available, and the value of the GBD lies not only in the data, but also in the critical discussion made possible by its comprehensive, longitudinal nature.

Chronic diseases are becoming more prevalent worldwide. Further public health efforts to curb the increase in potentially preventable risk factors can make the global population more resilient to public health crises such as COVID-19. This presentation will provide comprehensive data on various dietary risk factors, including dietary risks for death and disability in countries and regions of the world based on the latest GBD findings.

This presentation will also provide results from recent studies that projected future changes in the burden of disease in Japan attributed to dietary risk factors under a variety of future intake scenarios. Large gaps in future burden of disease estimates across scenarios were identified. This implies that policies targeting dietary risk factors in a given population may have a significant impact on the future trajectory of the risk factor profile and associated burden of disease within that population.

Keyword: Global Burden of Disease, dietary risks

Conflict of Interest Disclosure: None.

Further Collaborators: None.

SL(T3)2
The influence of diet on fertility and outcomes of assisted reproductive technologies

Audrey Jane Gaskins[1]

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The literature on the relation between diet and human fertility has greatly expanded over the last decade. At present, antioxidant supplementation does not appear to offer benefits to women undergoing infertility treatment, but it may be beneficial when it is the male partner who is supplemented. It is, however, unclear which specific antioxidants and which doses are responsible for this benefit. Maternal intake of supplemental folate, particularly at doses higher than those recommended for the prevention of neural tube defects, has been consistently related to lower frequency of infertility, shorter time to pregnancy, lower risk of pregnancy loss, and greater success in infertility treatment. Higher intake of other vitamins involved in one carbon metabolism, such as B12, may also be associated with enhanced fertility. On the other hand, vitamin D supplementation does not appear to play an important role in fertility in the absence of deficiency. Male and female intake of long chain omega 3 fatty acids (particularly from seafood) and fruits and vegetables (particularly from produce with low levels of pesticides) may improve fertility although it remains unclear to what extent contamination with environmental toxicants can dampen this benefit. Dairy and soy, once proposed as reproductive toxicants, have not been consistently related to poorer fertility in men or women. In fact, newer evidence suggests that soy foods and supplements could be beneficial for women undergoing infertility treatment. As more rigorous studies continue to be published, the evidence of a potentially deleterious effect of moderate alcohol and caffeine intake on the fecundability, pregnancy loss, and ART outcomes seems less solid than previously hypothesized. Overall, in women, adherence to a diet prioritizing intake of supplemental folic acid, vitamin B12, vitamin D, low pesticide fruits and vegetables, whole grains, seafood, dairy, and soy foods and limiting intake of high pesticide fruits and vegetables appears to be the most optimal pre-conception guidance. In men, adherence to a Mediterranean diet characterized by high intake of low pesticide fruits and vegetables, seafood, whole grains and limited intake of red and processed meat, refined grains, high-energy drinks, and sweets appears to be the best recommendations to enhance semen quality and fertility. While a complete picture of the role of nutrition on fertility is far from complete, the current state of the evidence stresses the importance of providing specific pre-conception guidance to couples planning pregnancy above and beyond general recommendations for chronic disease prevention.

Keyword: fertility, assisted reproductive technologies, pregnancy, diet patterns, supplements

Conflict of Interest Disclosure: No conflicts of interest to disclose.

SL(T3)3
The importance of nutrition for dementia and frailty: Evidence from epidemiological studies in aging

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Keeping a healthy diet throughout life is important for a healthy aging. However, at old ages, many individuals suffer from malnutrition due to a reduced food intake and disturbed metabolic regulation. Being malnourished is tightly intertwined with sarcopenia – loss of muscle mass and strength – and with frailty – a geriatric syndrome characterized by increased vulnerability and reduced ability to cope with stressors. In addition, these factors are also associated with an increased risk for the development of dementia. Hence, the mechanisms are connected and difficult to disentangle.

Observational studies have shown that vitamin B and E intake as well as poly-unsaturated fatty acids are beneficial for the prevention of frailty and dementia. Saturated fatty acids have an opposite effect. The evidence for effects from different diets have been mixed. However, saturated fatty acids typically reflect adherence to Western diets with relatively high amounts of animal fat. A neuroprotective effect is suggested from intake of vegetables, fruits, berries and sea-food, of which some components are found in different Mediterranean diets. However, for old frail individuals, it is important to have a high protein intake to counteract sarcopenia.

There are some RCTs conducted in pre-frail and frail individuals that show beneficial effects from protein supplementation and physical exercise. Another way of finding causal evidence for possible interventions is to use a Mendelian Randomization study, which is nature´s own version of an RCT. Then, genetic variants are used as proxies for an exposure to provide unbiased estimates with frailty and dementia outcomes. For example, genetic variants that explain part of the circulating serum albumin level can be used to analyze if high or low albumin levels are good or bad for frailty without bias from unmeasured confounders. In this way, epidemiological studies can provide clinical guidance of nutritional interventions that should have the potential to prevent against frailty and dementia.

Keyword: nutrition, frailty, dementia, epidemiology, Mendelian Randomization

SL(T3)4
Food insecurity and child growth and development

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Background and objectives: Children and adolescents are sensitive to their environments and vulnerable physically, psychologically, and socially to stressors in their environments. From developmental, life course, cumulative disadvantage, and intergenerational theoretical perspectives, stressors in the environments of children and adolescents can have substantial immediate and long-term consequences. Food insecurity is a common stressor in the environments of children and adolescents in all countries, with the prevalence of moderate or severe food insecurity in 2020 among individuals aged 15 years or above being 30% in the world, 60% in Africa, 26% in Asia, and 41% in Latin America and the Caribbean. The aim of this lecture is to summarize evidence on the consequences of food insecurity for children and adolescents with particular attention to growth and development.

Methods: The literature on food insecurity, how children experience it, and its consequences for children and adolescents was reviewed.

Results: Children and adolescents experience food insecurity cognitively, emotionally, and physically in ways that are different from adults. Children who experience food insecurity can live adult roles prematurely such as by participating in adult strategies to ensure adequate food, helping to generate resources by doing chores and participating in labor, and reducing their own food consumption to protect their parents and siblings from food insecurity. Food insecurity in families leads to distress and adverse family and social interactions, worry and anxiety, and feelings of deprivation and alienation. For children and adolescents, these experiences result in greater likelihood or intensity of behavioral problems, disrupted social interactions, compromised school performance, poor dietary intake, low physical activity, low physical function in daily activities and exercise, poor general physical health and illness, poor mental health, shame, and compromised growth and development.

Conclusions: Food insecurity is experienced by children despite attempts from adults to protect them from it. Food insecurity is a powerful stressor that harms children directly and through disruptions in parenting and family life. The consequences of food insecurity for children and adolescents are likely to have long-term effects that are cumulative throughout the life course and to be passed to the next generation. Therefore, continued efforts to prevent food insecurity and mitigate its consequence are needed and will result in long-term benefits for individuals.

Keyword: Food insecurity, Child growth, Child development, Stress, Health

SL(T4)1
Epidemiological evidence on nutrition, metabolome and cardiometabolic risk.

Paul Elliott[1]

1. Imperial College London (UK)

Geographical and temporal trends in disease rates – such as the declines in coronary heart disease mortality in many countries since the 1960s and 1970s and the current worldwide obesity and diabetes epidemics -- indicate the importance of the environment (including lifestyle, dietary and nutritional factors) in the development of cardiometabolic diseases. In this regard, the 'exposome' paradigm has been proposed as a means of representing the totality of exposures (including lifestyle, dietary and nutritional factors) that lead to an individual's risk of disease over the lifecourse. The exposome involves both exposure to 'external' stressors such as occupational, lifestyle and dietary factors and the 'internal' (biochemical) exposome which captures (among others) the biological imprints of these external stressors. Increasingly these biochemical signatures can be measured through use of omic technologies, among which metabolomics -- the measurement of small molecule metabolites in blood or urine by nuclear magnetic resonance (NMR) spectroscopy and/or mass spectrometry (MS) -- is key since it is the most proximal of the omic technologies to the phenotype. Specifically, metabolomics captures in high-resolution the end-products of metabolic pathways of the organism, from both physiological and pathophysiological processes, as well as providing direct measures (biomarkers) of lifestyle exposures including dietary intakes (1). The concept is that, against a background of genetic susceptibility, the external and internal stressors (represented by their associated molecular signatures) interact at a cellular and systems level to determine the trajectory of health or disease over the lifecourse. Agnostic (untargeted) analyses, including the metabolome-wide association study (MWAS) approach applied to epidemiological cohorts, have been utilised, for example, to reveal novel signatures of perturbations in metabolic pathways associated with adiposity (2), as well as targeted metabolomic analyses of specific pathways. Identification of nutritional biomarkers using such methods may lead to development of objective markers of dietary intakes and diet quality for use in epidemiological studies, and potentially in clinical practice. However, new methods of working involving a multi-disciplinary approach are required to address the computational and interpretational demands of the metabolomic approach.

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Keyword: Nutrition, Metabolome, Cardiometabolic risk

Conflict of Interest Disclosure: I confirm no conflicts of interest to disclose.

F**urther Collaborators**: Not applicable

SL(T4)2
Food, Nutrition and Cancer Risk: Pros and Cons of the Japanese Diet

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World Cancer Research Fund International evaluated obesity (colorectum, liver, breast, kidney, etc.), alcohol consumption (esophagus, colorectum, liver, breast, etc.) and processed meats (colorectum) to be "convincing" diet-related factors, and foods preserved by salting (stomach) and red meats (colorectum) to be "probable" factors that increase the risk of cancer. On the other hand, the fund evaluated physical activity (colorectum) as only "convincing" and fruits and vegetables (aerodigestive cancer and some other cancers aggregated), whole grains (colorectum), dietary fiber (colorectum), dairy products (colorectum), and coffee (liver, endometrium) as "probable" to lower the risk of cancer.

According to Global Burden of Disease Study 2019, the global excess mortality attributed to diet-related factors was estimated to be 6.1% of total cancer death world-wide aged 25 year and over. The breakdown is as follows: insufficient intake of whole grains (1.7%), milk (1.7%), calcium (1.4%), fruits (1.3%), vegetables (0.2%), and dietary fiber (0.2%), and excessive intake of red meat (0.8%), sodium (0.7%), and processed meat (0.3%). Except for fruit being esophageal and lung, vegetable being esophageal and sodium being stomach, all the rest are defined as attributing to excess colorectal cancer deaths.

The age-standardized cancer mortality rate in Japan is the lowest among the G7 countries, especially for breast and prostate cancer. On the other hand, stomach and colorectal cancers are relatively high.

The Japanese diet generally consists mainly of plant based-foods such as vegetables and soybeans and seafood and is eaten with sugar-free drinks such as green tea. They are low in calories and less lead to obesity (its prevalence is extremely low in Japan compared with the other G7 Countries), and in this aspect, they may be beneficial in cancer prevention. On the other hand, higher salted foods consumption such as salt pickled vegetables and salt preserved seafoods, raises the risk of stomach cancer, whereas low in calcium intake due to low milk and dairy products may increase the risk of colorectal cancer.

Soybeans are consumed predominantly in Asian countries, including Japan, and are the only source of isoflavones, which are similar in chemical structure to estrogen, a female hormone. It is thought to bind to estrogen receptors with weak estrogenic function in reproductive women and inhibit estrogen-induced tumor growth. Although evidence is limited in Western countries, consumption of isoflavones in the amounts consumed in Asian countries is associated with a lower risk of breast and

prostate cancer, and high soy intake may be associated with low mortality rates for breast and prostate cancer in Asian countries.

The current international evidence on food, nutrition and cancer risk will be introduced, as well as the relationship with Japan's unique diet.

Keyword: Cancer, Diet, Obesity, Salt, Soybean

SL(T4)3
Dietary strategy for diabetes and sarcopenia in the longevity society

Yutaka Seino[1] , Yuji Yamazaki[1]

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In the longevity society, diabetes and sarcopenia have significant impacts on the quality of our elderly life. Dietary therapy is a basic way to maintain our health and to make our health better. In general, a protein, fat, carbohydrate (PFC) balanced meal is recommended for health together with an appropriate total daily calory intake. Dietary therapy is also fundamental for prediabetes, diabetes, and obesity. Accumulated evidence has shown that “how we eat and what we eat” are closely associated with glucose homeostasis, due to various physiological factors such as gastric emptying and incretin effects and so on. Gastric emptying impacts on an intestinal absorption of nutrients, which is associated with postprandial blood glucose excursion in an insulin-independent manner. Nutrients absorption in gut stimulates the secretion of incretins in the intestinal endocrine cells, glucose-dependent Insulinotropic peptide (GIP) and glucagon-like peptide 1 (GLP-1), which enhance insulin secretion from pancreatic beta cells in a glucose dependent manner. Not only their insulinotropic effects, but they also play various roles in gastric emptying, the feeding center in brain, and others. Incretin signaling orchestrates glucose metabolism along with meal ingestions. While carbohydrate is associated with glucose homeostasis, protein intake is relevant for the prevention of sarcopenia, particularly, in the elderly people. A daily change of muscle mass is determined by a net balance of muscle protein synthesis and muscle protein degradation. Muscle protein synthesis is elevated a certain period after meal ingestion. Muscle mass is increased in a period of the time that the rate of muscle protein synthesis exceeds the rate of degradation. The duration of muscle synthesis per day are also incremented by several principles related to “how we eat and what we eat”. Here, I'll discuss about dietary strategy for diabetes and sarcopenia.

Keyword: Incretin, glucose homeostasis, sarcopenia

Conflict of Interest Disclosure: Consulting or speaker fees from:

Nippon Boehringer Ingelheim, Novo Nordisk Pharma Limited, Becton, Dickinson, Eli Lilly Japan, Ono Pharmaceutical, and Sumitomo Dainippon Pharma; clinically commissioned and joint research grants from Arklay, Nippon Boehringer Ingelheim, Novo Nordisk, Ono Pharmaceutical, Sumitomo Dainippon Pharma, and Taisho Pharmaceutical.

SL(T4)4
Nature, Nurture, and Type 2 Diabetes from a Nikkei Perspective

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Prior to the 1970's, diabetes prevalence was reported to be very low in Japan. Thus it was commonly believed that diabetes prevalence would also be low in Japanese Americans (Nikkei). However, a 1963 report demonstrated diabetes to be much more prevalent in Japanese Americans than in Caucasians on the island of Oahu in Hawaii. Furthermore, the Ni-Hon-San Study and the Hiroshima University Study pointed out in the 1970's that diabetes prevalence was higher among migrant Japanese populations in Hawaii and the San Francisco Bay area of California than in Japan. Thus the Japanese American Community Diabetes Study was begun in 1983 in Seattle, Washington to examine why this was the case by exploring the etiology and pathogenesis of type 2 diabetes among Japanese Americans who were Nisei (second generation) and Sansei (third generation) descendents of immigrants to the United States from Japan. This epidemiologic investigation was planned as a metabolic, longitudinal, population-based study that assessed lifestyle factors, insulin sensitivity, insulin secretion, and adiposity, including measurements of body fat distribution by anthropometry and computed tomography. An early important contribution from this research was the demonstration that visceral adiposity was a powerful risk factor for type 2 diabetes in Japanese Americans. In addition, among susceptible Japanese Americans lifestyle factors appeared to lead to weight gain, especially in visceral fat depots, that in turn led to decreased insulin sensitivity that in conjunction with reduced β-cell reserve, resulted in hyperglycemia and type 2 diabetes. This process can be retarded by dietary and exercise intervention. The lessons learned from studying migrant Japanese in Seattle may in many ways be applicable to the epidemic of diabetes that has been observed among other populations of Asian origin.

Keyword: Type 2 diabetes mellitus, Insulin action and secretion, Adiposity, Lifestyle factors

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SL(T5)1

Measures against obesity and metabolic syndrome in Japan: Findings from the specific health checkups and specific health guidance system

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Prolonging healthy life expectancy and preventing disparities in health status are major challenges in Japan. Health checkups and subsequent health guidance have played a key role in combating lifestyle-related diseases.

All health insurers in Japan are mandated to provide Specific Health Checkups and Specific Health Guidance focusing on metabolic syndrome in middle-aged adults, beginning in 2008. People who are abdominal obesity and have more than two metabolic risk factors are eligible for Intensive Health Guidance (HG). This program includes individual counseling or group sessions to give information about how to change lifestyle and set individual goals, with follow-up by e-mail, phone or interviews for six months, with a final evaluation.

We analyzed the examination data of 3,480 participants enrolled in the Intensive HG. Significant weight reduction and concomitant improvements in measurements associated with obesity-related diseases were observed in one year. In the group exhibiting a 1% to <3% weight reduction, TG, LDL-C, HbA1c, AST, ALT and γ-GTP decreased significantly, and HDL-C increased significantly compared to the control group. Significant reductions in SBP, DBP, FPG and UA were observed in the group with a 3% to <5% weight reduction. Based on these findings, setting goal of 3% weight reduction is thought to be feasible and effective.

We compared changes of risk factors and initiation of pharmacological therapy over three years between participants (n=31,790) and non-participants (n=189,726) who were eligible for HG in 2008. Participants in HG showed greater improvements in MetS profiles with proportionally smaller pharmacological treatment initiations than non-participants for three years. In the Intensive HG group, waist circumference, BMI, body weight, BP, TG and HDL-C were significantly improved in comparison to the corresponding control groups. Although selection bias may be present, this study suggests SHG would be a feasible strategy to prevent MetS and its sequelae.

The implementation rate of health guidance was 23.2%; meaning that in 2019 around 1.2 million individuals received SHG out of an eligible population of 5.2 million. The government is introducing incentives for insurers and seeking more efficient implementation methods in order to increase the implementation rate.

Since face-to-face guidance has become difficult due to the COVID-19, the number of cases of health guidance through online interviews and the use of apps is increasing. It has been reported that health guidance using the app makes it easier to understand changes in the subject's behavior and raises motivation. In this lecture, I will introduce new initiatives in Japan.

Keyword: metabolic syndrome, Health Checkups, Health Guidance, weight reduction

Conflict of Interest Disclosure: None
Further Collaborators: None

SL(T5)2

Ultra-processed foods, diet quality and health: evidence and policy implications

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All over the world, long-established dietary patterns based on a variety of unprocessed or minimally processed foods and freshly prepared meals made with these foods using processed culinary ingredients and some processed foods, are being displaced by ultra-processed foods (concepts and terminologies according to the Nova food classification system). Meta-analyses of data from large, long-duration, well-conducted cohort studies have shown that displacement of unprocessed or minimally processed foods and freshly prepared meals by ultra-processed foods increases the risk of obesity, diabetes, dyslipidaemias, cardiovascular diseases, stroke, depression, and also of earlier all-cause mortality. Other disorders and diseases prospectively associated with ultra-processed food intake include increased adiposity accumulation from childhood and adolescence to adulthood, hypertension, and gastrointestinal and liver diseases. A randomized controlled cross-over trial has demonstrated that ultra-processed diets cause passive dietary energy overconsumption and huge body fat mass accumulation. Part of these studies also show that the ill-effects of ultra-processed foods do not depend only on the use of high amounts of fat, sugar or salt in their manufacture. Other likely mechanisms are due to ultra-processing itself such as the destruction of the food matrix and the loss of the synergy existing in the original foods between nutrients and other bioactive compounds. Or the presence of harmful substances created by high temperatures and compression or released by synthetic packaging material. Ultra-processing also depends on the use of a myriad of additives whose effects on health, cumulatively and in combination, are unknown. This is why ultra-processed foods reformulated with less salt, sugar or fat remain harmful to health. Official national and international dietary guidelines should all emphasise a great diversity of unprocessed or minimally processed foods, mostly plants, and freshly prepared meals, and clearly state that ultra-processed foods should be avoided. National dietary guidelines already do so in Brazil, in other Latin-American countries, and also in France, Israel, and Malaysia. This is also the orientation of the 2021 American Heart Association Scientific Statement on Dietary Guidance to Improve Cardiovascular Health. Having a great variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly(ultra-) processed food and drink products is one of the FAO/WHO guiding principles for sustainable healthy diets. The emphasis on unprocessed or minimally processed foods and the avoidance of ultra-processed foods will also have social, cultural, economic and environmental benefits, including the support of local cooperative and family farming, retailing and catering

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DOI: 10.1159/000530786

businesses, and protection of authentic food cultures, non-renewable natural resources, and biodiversity. Statutory policies and programs to reduce the consumption of ultra-processed foods should now be put in place, approximating to those used with success to limit smoking and use of tobacco. Policies and programs are also needed to support, protect and encourage the production, distribution and consumption of unprocessed and minimally processed foods, and the preparation and enjoyment of fresh meals at home, schools, workplaces, hospitals, community facilities, and in affordable restaurants.

Keyword: Ultra-processed food, Diet quality, Health, Dietary guidelines, non-communicable diseases

SL(T5)3
Health literacy, public policy and nutrition: Making healthy food choices, easy choices

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Access to timely, accurate and reliable information is a fundamental determinant of health. The internet and digital communications have provided unprecedented access to information about food and nutrition. An overwhelming volume of information on food and nutrition is now accessible to many people, but much of it is presented in a form that is hard to understand, and in some cases, it is deliberately misleading – often designed to advance commercial interests. The challenge for many today is to find trustworthy information that is easy to understand and can be used in a practical way to inform decisions about food choices. In response to this challenge governments in many countries have implemented codes and regulations to help provide consumers with consistent and accurate information. Disappointingly, in most examples these regulations provide information that is difficult to interpret and hard to act on for many consumers. These interventions to improve access to trustworthy information have to be continuously monitored and refined, and need to be matched by improvements in people's skills to obtain, process, and understand health information. These personal skills and capacities are referred to as health literacy. This presentation examines approaches to improving health literacy by both changing the quality and accessibility of information on food choices, and improving individual's skills and capacity to obtain, understand and act on trustworthy information – to make health food choices, easy choices.

Keyword: Health Literacy, Nutrition, Public Policy, Health Education

Conflict of Interest Disclosure: None

Further Collaborators: None

SL(T5)4
Healthy longevity and the nutrition with AI computing technologies

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Currently, various technologies that use AI are being developed in the fields of food and nutritional science. There is great hope that AI can make a significant contribution to the field of food and nutritional science. AI will not only accelerate the efficiency of food production and processing but will also be of great help in developing better food products that include the immunomodulatory function of dietary components, dietary assessments, health claims in immune systems, dietary components that also affect the intestinal microbiota, and safety assessment of foods. Research has also begun to focus on the development of related technologies, such as the "AI Diatrofi", which aims to establish predictive models for the interaction between the simultaneous intake of multi-molecular food products and human health. Such studies have only recently begun to be conducted. Continued research is required to obtain reliable information in the future. The fields of food and nutritional science, food analytical methods, and AI will continue to complement each other. This is not limited to either nutrition or nutritional science, food analytical methods, or AI, but is intended to be of interest to people in both fields and to build a bridge for healthy longevity.

Keyword: Longevity, Nutrition, AI Diatrofi, Metabolism, Metabolome

Conflict of Interest Disclosure: No

Further Collaborators: No

SL(T6)1
Salt

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There is strong evidence for a causal relationship between salt intake and raised blood pressure which in turn is the leading cause of deaths, responsible for more than 10 million deaths a year worldwide. The World Health Organization has recommended a reduction in salt intake from the current level of ≈10 g/d in most countries to less than 5 g/d. This has been challenged by several cohort studies which suggested a J-shaped relationship between salt intake and cardiovascular disease (CVD). However, these studies have methodological issues, e.g. reverse causality, biased estimations of salt intake. Methodologically robust studies with accurate measurement of salt intake have shown a direct linear association with CVD events and mortality, down to an intake of 3 g/d. Indeed, a

reduction in population salt intake is one of the most cost-effective measures to prevent CVD.

The question now is how to effectively reduce salt intake. In many developed countries, most of the salt in the diet is from processed food, i.e. added by the food industry. A key strategy is to set incrementally lower salt targets for the industry to achieve within a clear timeframe. Such a target-based approach has been shown to be effective in reducing salt levels in foods and leading to a reduction in population salt intake. In many developing countries, most of the salt in the diet is added by the consumers during cooking or in sauces. Public health campaign plays a key role in encouraging individuals to reduce the amount of salt they use. Changing individual's dietary behavior is very difficult, however, new approaches have shown promising results. Studies have shown that schoolchildren could play a key role in helping the family to reduce salt intake. m-Health technology could be used to sustain salt reduction education. Replacing the usual salt with salt substitutes, which are made with reduced sodium and increased potassium, have been shown to lower blood pressure and CVD and total mortality. Every country should develop and implement a coherent, workable strategy to reduce salt intake. Even a modest reduction in population salt intake will have enormous health and economic benefits.

Keywords: Salt reduction, Evidence, Implementation

Conflict of Interest Disclosure: FJH is an unpaid member of Action on Salt and World Action on Salt, Sugar, and Health (WASSH).

SL(T6)2
An apple a day to keep the doctor away? Fruit and vegetable consumption and links with chronic disease

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1. University of Cambridge (UK)

The massive global burden of non-communicable chronic diseases such as cardiovascular disease, type 2 diabetes and cancer poses a serious crisis for which urgent solutions are needed. Diet and nutrition are critical to this goal.

As part of this strategy, the public health recommendation of “five-a-day” has been around for decades, promoting the consumption of at least five portions daily of fruits and vegetables for good health and longevity. By now this message is widespread worldwide and has gained even greater prominence because of the increasing interest in plant-based diets for human health and planetary sustainability.

This session will examine dietary guidelines on fruit and vegetable promotion, where are we with achieving the public health goal, what the barriers and facilitators are, and consider how quantity and variety of dietary intakes are relevant for human health but how it has been challenging to study this link. As well, we will examine the wider influences on fruit and vegetable consumption including the impact of the COVID-19 pandemic.

We will also consider how the use of nutritional biomarkers and new ‘omics technologies are offering the objective assessment of fruit and vegetable consumption with greater precision to overcome the limitations of subjective assessment using dietary self-report and how this can help with the potential for personalised nutrition.

Keyword: Fruits, Vegetables, Chronic disease, Nutritional biomarkers, Barriers and facilitators

Conflict of Interest Disclosure: None

SL(T6)3
Improving nutrition in Japan and its factors

Teiji Nakamura[1]

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The traditional Japanese diet is being considered healthy by people around the world. However, this is not necessarily true. Around 150 years ago, the diet of most Japanese people was simple and suffered from many nutritional deficiencies. Meiji government introduced nutrition science from Europe to make the nation wealthy and strong. Around the end of World War II, the country was burnt to the ground and there was severe hunger with no food and no money.

In 1945, the year the war ended, Japanese dietitians were created by national license and in 1952 the “Nutrition Improvement Law” enacted and full-scale nutritional improvement began as a national policy. A distinctive feature of Japan's nutritional improvement is that nutrition policy have been drawn up based on scientific evidence, and dietitians who serve as practical leaders, have been placed as professionals in group feeding facilities such as infant hospitals, kindergartens, schools, hospitals, welfare and other facilities.

In other words, based on the principle of Universal Health Coverage (UHC), a system of improved nutrition have been created for the entire life course of the population, creating a society where no one is left behind and everyone has access to healthy diets and nutrition education. In traditional Japanese diets of low nutrition, and Western diets of over-nutrition is reasonably mixed, and then healthy Japanese diets that balanced nutrition has been formed. Comprehensive nutritional improvement based on adequate supply and distribution of food, as well as nutrition education have been effective not only in preventing post-war undernutrition, but also non-communicable diseases caused by over-nutrition after economic development.

While food and economic assistance can be effective in providing nutritional support in emergencies caused by war and hunger, these alone can make it difficult to improve nutrition once international assistance ends, leaving people suffering from the double burden of malnutrition, where obesity and undernutrition coexist. The Japanese experience of building a healthy and long-lived nation, starting from post-war hunger and building a society where all people have access to healthy food and nutrition through aggressive nutritional improvements, is collectively known as “Japan nutrition”.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

In recent years, it has become clear that nutrition is not only related to health, but also to education, labor, the economy, gender and the environment, and that improved nutrition is fundamental to achieving the SDGs. We want to make use of this "Japan nutrition" to make an international contribution to developing countries in Asia, Africa and elsewhere by promoting practical nutrition research, training people in nutrition improvement, and supporting the establishment and development of nutrition policy and dietitian systems.

Keyword: Japan nutrition, Nutrition Improvement, double burden of malnutrition, dietitian

SL(T6)4
Improving access to healthy local and traditional foods within First Nations communities in Canada

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Introduction: Ongoing impacts of colonization and Indian residential schools have contributed to the higher prevalence of food insecurity and chronic disease within First Nations communities in Canada relative to the general population. However, Indigenous communities are increasingly reclaiming local and traditional foods and food skills to improve food security and advance food sovereignty and holistic health. Learning Circles: Local Healthy Food to School (LC:LHF2S) used Learning Circles (LC), a community capacity-building model, to bring together diverse stakeholders (including Indigenous knowledge keepers, community members, hunters, gatherers, farmers, food producers, teachers, school administrators, students and parents) to participate in an iterative cycle of planning, prioritizing, implementing and assessing actions to support their local school community food system. Building on initial experience in Haida Gwaii, BC, the model was also evaluated across three First Nations school communities in the provinces of BC, Saskatchewan and Manitoba that varied in context, including governance, geography, size and food systems. An LC facilitator was hired in each community to oversee and support food activities and evaluation.

Objectives: The objectives of the evaluation across 2016-2019 were to 1) document local food system actions, 2) examine the LC model of food system capacity building as scaled up across diverse contexts, and 3) document perceptions of annual cross-community project team gatherings as an integrated knowledge mobilization approach.

Methods: This community-based participatory action research used Indigenous and Western methods to gather and thematically analyze data from documents (community reports, tracking sheets), conversational interviews (n=52) and open-ended responses on two student surveys (n=171). The process of scale-up was guided by Foster-Fishman and Watson's ABLe Change Framework (2012).

Results: Food systems action was evident in each context and included development of local and traditional food pantries, school gardens, school nutrition programs and land-based learning from Indigenous knowledge keepers. Initiatives ranged from "quick wins", like a healthy community feast to raise funds for school food projects, to improving infrastructure to support local and traditional food access. Across communities, the LC facilitated a process to: 1) identify and build on strengths to increase capacity to reclaim traditional and local food systems; 2) strengthen connections to land, and traditional ways of knowing and doing; 3) foster relationships, community-level action and multi-sector collaboration; and 4) improve access to and perceived value of local healthy and traditional foods in school communities. Local champions supported community readiness for food-related action and Spirit of Collaboration research protocols helped decolonize research processes. Annual gatherings of community members, partners and research team facilitated relationship building, knowledge sharing and cross-community support of food project and evaluation processes.

Conclusion: The LC model helped to engage and empower community members across diverse First Nations contexts to drive actions to enhance local and traditional food access and food skills among youth. Ultimately, the actions advance food sovereignty and holistic wellness for Indigenous communities. Respectful, reciprocal partnerships between community members, researchers and partners contributed to a process of learning and action towards reconciliation and decolonization.

Keyword: First Nations, Food Security, Food Sovereignty, Community Capacity Building, Participatory Research

Acknowledgements: We acknowledge, gratefully, community collaborators, funders (CIHR, HSF) and other partners.

Conflict of Interest Disclosure: No conflict of interest to disclose.

Further Collaborators: We acknowledge community advisors, community participants, Learning Circle facilitators, research collaborators, partners, including Heart and Stroke Foundation of Canada, Storytellers' Inc., Farm to Cafeteria Canada, the CIHR PEKE: Native Women's Association of Canada and (main funder) CIHR Pathways to Health Equity for Indigenous Peoples

SL(T7)1
Biochemical mechanisms of the health benefits of curcumin

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Curcumin, prepared as an extract from the rhizome of the turmeric plant, is one of the most widely consumed dietary supplements. Curcumin is best known for its anti-inflammatory effects, with frequent use of curcumin dietary supplements by consumers seeking relief for arthritis, pain, and other persistent inflammatory conditions. The ever increasing popularity of curcumin as a treatment for inflammatory conditions by the general public has, for a long time, lacked support by evidence from well-designed and executed clinical trials. Our interest has

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DOI: 10.1159/000530786

been to elucidate the chemical and molecular mechanisms of how curcumin exerts biological activity, using its anti-inflammatory activity as example. Curcumin is unstable in aqueous solution at physiological pH, resulting in rapid degradation. We have identified the degradation products and their mechanism of formation and characterized the overall degradation reaction as an autoxidation. Autoxidation is initiated by hydrogen abstraction from the phenolic hydroxyl and proceeds via radical-driven cyclization reactions and the incorporation of molecular oxygen to yield a final bicyclopentadione derivative of curcumin. Among the intermediates in the degradation reaction are unstable and reactive electrophiles featuring quinone methide and epoxide moieties. We hypothesized that the electrophiles may exert biological effects via protein adduction at redox-active cysteine residues of curcumin target proteins. We characterized binding of electrophilic curcumin degradation products to a cysteine residue of IkB kinase b (IKKb), the kinase that activates NF-kB, a transcription factor involved in inflammation and cancer. The final and stable product of curcumin (bicyclopentadione) did not inhibit NF-kB, and the activity of synthetic curcumin analogues correlated with their chemical stability. The chemically more unstable analogues that more readily underwent autoxidation to electrophilic products were also more potent inhibitors of NF-kB. This supported the hypothesis that curcumin serves as a pro-drug and that its anti-inflammatory effects on NF-kB are mediated by its electrophilic degradation products. This was further confirmed upon analysis of covalent binding of the degradation products to a peptide containing the target cysteine within the redox-regulatory domain of IKKb. Our studies identified curcumin as a pro-drug requiring activation by metabolic oxidation in order to exert anti-inflammatory effects. Insufficient activation of curcumin in vivo may be contributing to a lack of showing clear therapeutic benefits in human clinical trials.

Keyword: turmeric, pro-drug, metabolic activation, electrophile, protein adduction

SL(T7)2
Food Bioactive Peptides -Past, Today and Future Perspective.

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Nowadays, food is recognized as a source of dietary substances and biologically active compounds that improve human health beyond traditional nutrient's source. In recent years, numerous reports have been published describing bioactive peptides/hydrolysates produced from various food sources. Bioactive peptides generated from food proteins have great potential as functional foods and nutraceuticals. These peptides are inactive within the sequence of parent protein and can be released during gastrointestinal digestion or food processing. The production of food-derived bioactive peptides is mainly through the hydrolysis of digestive enzymes and proteolytic enzymes or microbial fermentation. Most bioactive peptides range between two (dipeptides) and 20 amino acid residues and have a molecular mass of 0.4–2 kDa. Depending on the amino acid sequence, bioactive peptides possess several significant functions, such as antioxidative, anti-inflammatory, anticancer, antimicrobial, immunomodulatory, and antihypertensive effects in the living body. We highlight the history of food derived bioactive peptide research (plant and animal), extraction of bioactive peptides, bioassay of bioactive peptides, peptides analytical tools, bio accessibility and bioavailability testing in ex-vivo and in vivo, and clinical aspect of these peptides. We also introduce the application of bioactive peptides in functional food development, pharmaceutical and cosmetic industry as well as challenges, and prospects of food-derived bioactive peptides.

Keyword: bioactive peptide, functional foods, nutraceuticals, human health

SL(T7)3
Food function on disease

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Nowadays, humankind is entering the Age of Discovery in the 21st century. The space environment causes various physical changes. One of the changes is muscle atrophy (sarcopenia). We aim to elucidate the mechanism of this weightless muscle atrophy and devise a nutritional treatment for it. Previous studies have shown that ubiquitin ligase Cbl-b, of which expression is increased by microgravity, induced IRS-1 ubiquitination and degradation, resulting in impaired IGF-1 signal and muscular atrophy. However, it remains unclear how cells sense weightless stress and enhance Cbl-b expression. Therefore, to clarify the mechanism of gravity sensing by these cells, we conducted “Myolab” and “Cell Mechanosensing” space experiments, and 3D-Clinorotation, which is a simulated microgravity culture device on the ground. First, in the Myolab space experiment, we performed metabolome analysis of space samples cultured under microgravity conditions for a week. Then we found that microgravity accumulated oxidative stress in cells and changed the expression of proteins localized in mitochondria related to energy metabolism. It was also found that the oxidative stress regulates the expression of ubiquitin ligase Cbl-b via Egr1 / 2 and ERK1 / 2 pathways. Thus, we considered ubiquitin ligase Cbl-b and oxidative stress as targets for functional foods that can prevent muscle atrophy due to weightlessness.

1) Soy protein (anti-ubiquitinating effect): We discovered a DG (p) YMP peptide (named Cblin peptide) that has an inhibitory activity on the binding of IRS-1, which is the target molecule of ubiquitin ligase Cbl-b. Furthermore, it was found that the soy protein glycinin has a similar sequence. These suppressed the ubiquitination of IRS-1 by Cbl-b and increased muscle mass in *in vitro* and *in vivo* experiments. In addition, the soy protein-added

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

diet was also effective in suppressing muscle weakness in bedridden patients.

2) **Polyphenol (antioxidant effect**): Polyphenols are attracting attention as a dietary ingredient that can reduce antioxidant stress. Antioxidant nutrients such as soy isoflavone and quercetin have been shown to suppress muscular atrophy due to tail suspension.

Because of the usefulness of these functional ingredients of soybeans for such muscle atrophy, we are advocating the construction of a plant factory that can make soybeans self-sufficient in the space environment.

Keyword: oxidative stress, ubiquitin ligase, anti-oxidative nutrients, soy protein, muscle atrophy

Conflict of Interest Disclosure: There is no conflict of interest disclosure.

SL(T7)4
Branched-chain amino acids as functional foods.

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1. Chubu University (Japan)

Branched-chain amino acids (BCAAs: leucine, isoleucine, and valine) are indispensable amino acids for mammals, and the catabolic system for BCAAs is equipped in mammalian cells to dispose of excess BCAAs. The main BCAA catabolic pathway is localized in the mitochondria of almost all tissues. The first 2 steps of the catabolic pathway are common to the three BCAAs. The first step reaction is the transamination of BCAAs to form branched-chain α-keto acids (BCKAs), which is a reversible reaction catalyzed by branched-chain aminotransferase (BCAT). Two isozymes of BCAT have been reported; one is a mitochondrial type (BCATm or BCAT2) that is expressed in all of the peripheral tissues except for liver, and the other one is a cytosolic type (BCATc or BCAT1) that is unique to cerebral tissues, placenta, and ovaries. The second step reaction is the oxidative decarboxylation of BCKAs to form CoA esters, which is catalyzed by BCKA dehydrogenase (BCKDH) complex. Since this reaction is irreversible, it is thought that BCKDH complex is a primary regulator of the BCAA catabolism. Furthermore, BCKDH complex is regulated by covalent modifications: the complex is inactivated by phosphorylation of the complex and reactivated by dephosphorylation. BCKDH kinase (BDK) and BCKDH phosphatase are responsible for these modifications, respectively. These reactions allow the rapid conversion of the activity state of BCKDH complex in response to alterations in the nutritional and physiological conditions of the animals. BDK, compared to BCKDH phosphatase, is tightly bound to the complex and its activity is inversely related with the complex activity, suggesting that BDK is a main regulator of the BCKDH complex. Although the concentrations of free BCAAs in blood and tissues at the postabsorptive state in humans are relatively stable due to the strictly regulated catabolic system described above, the plasma concentrations are rapidly elevated by ingestion of free BCAAs. This elevation of the plasma concentrations of BCAAs (especially leucine) promotes protein synthesis and inhibits protein degradation in tissues. Due to the anabolic effects of BCAAs, a mixture of BCAAs is used as a pharmaceutical for liver cirrhotic patients to increase the plasma albumin concentration. It has been reported that liver cirrhotic patients suffered from frequent muscle clamp and that BCAA supplementation to the patents markedly decreases frequency of the muscle clamp. It has also been demonstrated that BCAA supplementation right before exercise significantly decreases delayed-onset muscle soreness (DOMS), probably due to decreasing muscle damage caused by the exercise and promoting recovery of the muscle after exercise. Recent studies demonstrated that BCAAs are used in the brain tissues to produce glutamate as a neurotransmitter. It was found that mice deficient for BDK significantly reduced the BCAA concentrations in plasma and brain due to the activation of BCKDH complex and showed neurological abnormalities. Subsequently, patients with homozygous BDK mutations were identified and it was found that the patients showed markedly low levels of plasma BCAAs and presented with autism, intellectual disability, and epilepsy. These findings indicate that BCAAs are effective supplements for skeletal muscle and brain.

Keywords: BCAAs, BCAA catabolic system, skeletal muscle, brain

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SL(T8)1
The benefits of a colourful diet

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The appreciation of the challenges of achieving global food security has matured to include nutritional security, as scientists have realized that not only calorie content but also food composition impact our health and well-being, dramatically. The ways that the nutrients we consume affect our health are highly complex due to the diversity of what we eat, the varying digestibility of what we eat, the changing composition and functioning of each individual's gut microbiota, the differences in absorption and bioavailability of the nutrients we eat, the differences in responses between individuals to what they eat and the multi-fold mechanisms of action that nutrients have on our health. However, one generic conclusion is possible: it has been accepted for more than 50 years that diets rich in plants, particularly fruit and vegetables, protect health. Yet over this same period diets have declined, with lower fruit and vegetable content replaced by more cheap, sugary, oily processed foods. These dietary shifts are having a marked impact on the incidence of chronic diseases; obesity, metabolic diseases, type2 diabetes and cardiovascular diseases. By understanding which nutrients from plants confer greatest benefits and how they protect against specific diseases (a process termed comparative nutrition) we hope to achieve dietary improvements at all levels in society. I hope to illustrate the potential of dietary improvement using plant-based foods to improve our health and

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

quality of life and to reduce the economic burden on our health-care systems.

Keyword: Fruit, Vegetables, Polyphenols, Vitamins

SL(T8)2
Protein and amino acid need in health and disease: new knowledge and discoveries

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Introduction: Dietary protein is a key nutrient which modulates our long-term health. Adequate intake of protein through all stages of life from conception to aging ensures that our body maintains ideal muscle mass, and overall body functions. In humans body proteins are made of 20 amino acids, among which 9 are considered essential to be obtained from diet. Thus, dietary reference intakes (DRI) are provided for protein and the 9 essential amino acids. The most recent recommendations are from the 2005 DRI's and the 2007 Food and Agriculture Organization (FAO)/World Health Organization (WHO) guidelines. However, the recommendations are predominantly based on young adult men, with a factorial determination for other life-stages.

Protein and amino acid requirements: We have embarked on a re-assessment of protein and amino acid requirements using novel stable isotope-based techniques during key life-stages including young children, pregnancy, elderly and in disease. Our new discoveries include estimated average requirements (EAR) for adult men (0.9g/kg), children (1.3g/kg), early pregnancy (1.2 g/kg), late pregnancy (1.5g/kg), elderly 65-80y (0.85-0.96g/kg), malnourished children (1.55g/kg) and children with in-born error of metabolism, Phenylketonuria (1.85g/kg). These values all differ substantially from current recommendations by 30-50% and have implications for the maintenance of 'optimal' health in healthy individuals, and to ensure recovery from disease in patients. We have also made significant discoveries on amino acid requirements, including the finding that key essential amino acids lysine, phenylalanine requirements are higher in late pregnancy compared to early stages, and that glycine, a non-essential amino acid is conditionally-essential in late stages of human pregnancy. In elderly men and women, we showed that the essential amino acid leucine requirements are nearly doubled compared to young adults (80 mg/kg vs 39 mg/kg, respectively). We also showed that supplementing both young and elderly men is safe with a tolerable upper intake level (UL) of 500mg/kg.

Translating protein requirements – Protein Quality: Ultimately our findings from the requirement studies needs to be translated to human diets, and this requires an understanding of the quality of the protein in foods. Protein quality of foods is determined by several factors including the amino acid composition of the foods, digestibility and bioavailability in vivo for protein synthesis. In general plant-based protein are usually limiting in one or more essential amino acid, with lysine being the key limiting amino acid. Using novel stable-isotope based methods we have shown recently that in young men and children, lysine bioavailability varies across cereal grains such as rice, oats and pulses such as chickpeas and lentils. Furthermore, bioavailability is reduced due to heat treatment and food processing. Additional work is ongoing on devising better food-based recommendations to ensure human populations can meet sufficient protein and amino acid needs from diets, with an increased understanding of requirements and protein quality.

Conclusions: Protein and amino acid recommendations in health and disease are underestimated. To ensure that optimal body needs are met revision of current recommendations with an understanding of the bioavailability/protein quality of foods is necessary.

Keyword: protein, amino acids, requirements, pregnancy, elderly

SL(T8)3
New perspectives on the delivery of bioactive compounds through food structure design

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All foods come from living organisms in which macromolecules, such as proteins and polysaccharides are synthesized, modified and assembled into complex hierarchical structures, such as organelles, cells and tissues. Many of the nutrients and bioactive compounds are contained within these structures, from which they must be liberated and converted into an absorbable form during digestion. It is now realised that the modification of these structures during digestion play a key role in determining the bioaccessibility and rates of absorption of bioactive compounds. Therefore, an understanding of the spatial organisation and interactions of the structure units in natural foods and how they change from raw material harvesting to processing and consumption is paramount. In the manufacture of fabricated foods, the concept of "food structure design" has emerged recently as a way of guiding new product development. This is based on the idea that specific food structures with tailored functionality can be developed through interactions and assembly of food biopolymers and ingredients through mixing, shearing, heating and cooling processes. While considerable research has been undertaken in developing food structures to control the perception of fat, salt and sugar in food products, the role of food structure as a variable in nutrient and bioactive delivery is relatively less understood. Understanding the architecture and structures of foods and how they interact within the physiological environment of the GIT could lead to new foods that provide optimal bio-accessibility and absorption of bioactive compounds. Recent work at our institute has demonstrated the importance of understanding the state and structures of food materials and biopolymer interactions in the environment in the GIT, in particular in the stomach, and the critical role of 'modified' structures on the kinetics of the release

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of nutrients and bioactive compounds from the food matrix (e.g. the rate, extent and type of released nutrients), gastric emptying and subsequent digestion of foods in the small intestine. The use of dynamic *in vitro* digestion in combination with *in-vivo* studies has provided new insights into the structural dynamics of complex food systems and subsequent interactions of food components during the gastrointestinal transit. This presentation will provide an overview of the approaches used for understanding the complex interactions in complex food systems within the environment of the GIT, with examples of recent work from our laboratory on the structural changes in natural and fabricated food systems during the digestion process.

Keyword: Food structure, Digestion, Nutrient delivery, GIT, biopolymers

Conflict of Interest Disclosure: N/A

SL(T8)4
Food Safety – Internationally Agreed Framework

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Food safety continues to be an important issue in the world for protecting the health of consumers. Foods are traded internationally and ensuring food safety is also important for facilitating trade. For these two objectives, we need to note one international agreement, the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organization (WTO), and one international body, the Codex Alimentarius Commission (CAC). The SPS Agreement covers measures for human, animal and plant life and health in relation to international trade. These measures are to be: "based on scientific principles" and "not maintained without sufficient scientific evidence"; based on "international standards, guidelines or recommendations, where they exist"; and "based on an assessment of the risks". For food safety, the SPS Agreement explicitly name the CAC as the international standard setting body. The SPS Agreement states that members of WTO shall play a full part in the CAC for food safety recommendations. The CAC is a joint FAO/WHO intergovernmental organization. Its major purpose is, among others, protecting the health of consumers and ensuring fair practices in the food trade. There are 189 members (including European Union), 243 observer organizations. Its first meeting was held in 1963. Under the CAC, which is supported by the Executive Committee, there are many subsidiary bodies: 10 general subject committees; 12 commodity committees (4 active and 8 adjourned *sine die*; and 6 regional committees. These committees are operated jointly by the Codex Secretariat and respective host countries. The CAC develops standards, codes of practice, guidelines and other recommendations through discussions among its members. For food safety and feed safety, the CAC takes science-based and risk-based approach. Since 1993, the CAC developed the definitions of the terms and working principles for risk analysis for use by itself and its members. The CAC works as risk manager. The Joint FAO/WHO Expert Committee on Food Additives (also on contaminants, natural toxins and veterinary drugs), Joint FAO/WHO Meeting on Pesticide Residues, and Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment act as risk assessors. They are independent from the CAC and participated by individual scientists. The priority of risk assessment by these scientific bodies is determined by the respective Codex committees. Risk analysis concept is used not only in the areas of food safety (pathogenic microorganisms, contaminants and natural toxins, residues of pesticides and veterinary drugs, and food additives) but also in the area of nutrition where both malnutrition and overdose of nutrients may pose health risks. For developing safety standards, there is an absolute need for scientific data, such as occurrence data to which the ALARA principle is applied; and trial data following good practice, etc. The safety of the standards is checked by exposure assessment using the occurrence data/trial data and the model consumption data of related foods.

Keyword: food safety, Codex Alimentarius Commission, risk analysis, SPS Agreement

Conflict of Interest Disclosure: None applicable

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Annals of Nutrition and Metabolism

Special Symposia

SSY1-2

Policy and financial commitments to nutrition made through the Tokyo Nutrition for Growth Summit 2021 - anatomy of success

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Under the umbrella of the UN Decade of Action on Nutrition, In December 2021 the Government of Japan convened the Tokyo Nutrition for Growth Summit. The summit called for policy and financial commitments in three main focus areas: (1) Integrating nutrition into Universal Health Coverage (UHC); (2) Transforming the food system to promote safe, sustainable, and healthy foods to support people and planet; (3) Effectively addressing malnutrition in fragile and conflict affected contexts, supporting resiliency; in addition to promote data and monitoring of nutrition indicators and drive innovation in nutrition financing. The summit was prepared by the Government of Japan through intensive involvement of several stakeholders from the UN, governments, civil society, philanthropies and through the active role of the Scaling Up Nutrition Movement. At the Tokyo Nutrition for Growth Summit, national governments and various stakeholders reaffirmed their commitment to the Decade and to driving greater action on nutrition. Overall, 396 new nutrition commitments were made by a total of 181 stakeholders covering 78 countries across the thematic areas of health (67%), food (63%), resilience (41%), accountability (27%) and financing (27%). This includes 224 commitments to address all forms of malnutrition from 80 government departments/ministries in 66 countries. Donor governments and donor organizations committed new nutrition-specific and nutrition-sensitive financing of about US$ 27 billion to tackle malnutrition. In addition, four governments committed to increase national budget allocations to nutrition. Accountability to nutrition has been strengthened through the Nutrition Accountability Framework, a platform for assessing and tracking the nutrition financing landscape and the Nutrition for Growth commitments provided by the Global Nutrition Report. It is critical these commitments are implemented and lead to intensified action addressing the growing nutrition challenges

Keywords: Nutrition, Universal Health Coverage, Food systems, Fragile countries, Policy

Conflict of Interest Disclosure: None

SSY2-1

Current progress and challenges in sodium reduction in Brazil

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Brazilians consume approximately double the World Health Organization (WHO) recommended maximum limit for sodium and excessive sodium intake causes over 47 thousand deaths from cardiovascular disease (CVD) in the country. About 40% of Brazilians' dietary sodium comes from industrialized foods, while 55% comes from added table salt, therefore sodium reduction policies in Brazil have incorporated a set of strategies. Current sodium reduction policies include health education campaigns based on the National Dietary Guidelines, especially targeted to the table salt added to foods and meals, food procurement and school meal standards limiting sodium in foods, improvement of nutritional labeling, and food reformulation strategies aimed at voluntarily reducing the sodium content of processed and ultra-processed products. From 2011 to 2017, all food categories have reduced their upper limits of sodium, and most have reduced their average sodium content, from 8 to 34% and these reductions may prevent or postpone approximately 2,900 deaths from CVD over the next 20 years. However, sodium reduction and health outcomes would be increased by implementing stricter mandatory sodium limits, effective front-of-package labeling, and possibly using low sodium table salt at the population level. Brazil's main challenges in sodium reduction are including other strategies to the existing multi-component policies and improving the current strategies, such as using the WHO Global Sodium Benchmarks for setting new targets for industrialized foods and transitioning to mandatory sodium limits in foods, improving communication and social marketing, and implementing effective front of package nutritional labeling for consumers.

Keywords: Sodium, Sodium reduction, Food policy

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SSY2-03

United States Population Sodium Reduction: National Strategy, Progress and Surveillance

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Americans consume on average 3,400 milligrams (mg) of sodium per day—nearly 50%more than the 2,300 mg limit recommended by federal guidelines for people 14 years and older. Too much sodium can raise blood pressure, which is a major risk factor for heart disease and stroke. More than 4 in 10 American adults have high blood pressure and that number increases to almost 6 in 10 for non-Hispanic Black adults. Additionally, about one in 10 children (8-12 years) and one in 8 teens (13-17 years) has elevated or high blood pressure. Reducing sodium intake has the potential to prevent hundreds of thousands of premature deaths and illnesses in the coming years. The FDA's goal to reduce sodium intake is consistent with the Dietary Guidelines for Americans, 2020-2025 and the 2019 National Academies of Sciences, Engineering, and Medicine Dietary Reference Intakes Report on Sodium and Potassium. External Link Disclaimer. To gradually reduce sodium across the food supply, the FDA is taking an iterative approach that includes establishing voluntary sodium targets for industry, monitoring and evaluating progress, and engaging with stakeholders. The FDA issued the final guidance with voluntary targets for reducing sodium in commercially processed, packaged and prepared food over the next 2.5 years. The approach supports sodium reduction efforts already made by industry, provides common targets for defining and measuring progress, and provides companies with the flexibility and time to meet these targets. The FDA's approach encourages a level playing field by setting voluntary targets for both processed and restaurant foods. To achieve a significant impact, the FDA is especially encouraging adoption by food manufacturers whose products make up a significant proportion of national sales in one or more categories and restaurant chains that are national and regional in scope. There are 16 overarching categories with individual sodium targets for 163 subcategories of food in recognition that a one-size approach does not fit all. The targets in the final guidance are designed to support decreasing average daily sodium intake by about 12 percent—from approximately 3,400 milligrams (mg) to 3,000 mg. The FDA will monitor the sodium content of the food supply, evaluate progress towards achieving the targets in the final guidance and engage with stakeholders on sodium reduction efforts and the targets. Dietary sodium intake will also be evaluated though the National Health and Examination Survey (NHANES). Preliminary evaluation finds that industry has made progress against the voluntary targets in many categories. Additional surveillance is in progress. The FDA expects to issue revised subsequent targets in the next few years to facilitate a gradual, iterative process to reduce sodium intake.

Keywords: Sodium, Hypertension, Surveillance

Conflict of Interest Disclosure: None

SSY2-4

Methods for estimating the potential dietary and health impact of compliance with WHO global sodium benchmarks- case studies from Australia and India

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Background and objectives: In 2021, the World Health Organization (WHO) set global sodium benchmarks for 58 packaged food categories, to help countries establish sodium reformulation programs for lowering sodium intake and preventing related diseases. The potential health impact of adopting the WHO sodium benchmarks differs in each country, largely due to different dietary intake and food supply. Therefore, having methods to estimate the potential effect of achieving the WHO sodium benchmarks is crucial for informing policy decisions. We describe the methods for estimating the potential reduction in sodium intake, and the number of deaths, new cases of diseases, and disability-adjusted life years (DALYs) that could potentially be averted if the WHO sodium benchmarks were adopted using Australia and India as case studies.

Methods: The reduction in sodium intake after reformulation towards the WHO benchmarks was estimated through five steps and then comparative risk assessment models were used to estimate the associated cardiovascular disease (CVD), chronic kidney disease (CKD) and stomach cancer deaths, incidence, and DALYs averted. First, pre-reformulation sodium intake from each WHO packaged food category was estimated using dietary intake and food composition data. Second, the pre-reformulation average sodium content of each food category was calculated using brand-specific sodium content data for packaged foods and sales weighting where possible. Third, the post-reformulation average sodium content for food categories was calculated with the assumption that targeted products with current sodium levels above the WHO sodium benchmarks were reformulated to the benchmark level, whereas products with sodium levels below the benchmarks remain the same. Fourth, the proportional reduction in sodium content for each food category was calculated by dividing the post-reformulation by the pre-reformulation average sodium content. Fifth, the post-reformulation sodium intake by food category was calculated by multiplying the pre-reformulation sodium intake (step 1) by the proportional reduction in sodium content (step 4) for each food category, and the sum across food categories is the overall sodium intake post-reformulation. The reduction in sodium intake post-reformulation is then used to estimate the effect on blood pressure, CVD, CKD and stomach cancer using data from the Global Burden of Disease and previous studies.

Results: In Australia, about 45% of average sodium intake (1527 mg/day) comes from the packaged foods targeted by the

WHO's sodium benchmarks. Compliance with the WHO's sodium benchmarks could lower average adult sodium intake by 404mg/day (12% of total sodium intake). This could prevent about 1,770 deaths/year (95% uncertainty interval 1,168 to 2,587), corresponding to 3% of all CVD, CKD and stomach cancer deaths in Australia, and prevent some 6,900 (4,603 to 9,513) new cases, and 25,700 (17,655 to 35,796) DALYs/year from CVD, CKD and stomach cancer. The potential health impact in India is to be determined.

Conclusion: Methods for estimating the potential health gains of sodium benchmarks for packaged foods are presented, providing a step-by-step process for countries to follow. In Australia, where packaged foods are a major source of sodium, adopting the WHO's strict and comprehensive sodium benchmarks can have substantial health gains.

Keywords: salt, food policy, nutrition, hypertension

Conflict of Interest Disclosure: KT has a strategic leadership role in the World Health Organization Collaborating Centre on Population Salt Reduction at the George Institute for Global Health. FJH is an unpaid member of Action on Salt and World Action on Salt, Sugar and Health. MM reports research funding from WHO India and Resolve to Save Lives, an initiative of Vital Strategies, funded by grants from Bloomberg Philanthropies; the Bill and Melinda Gates Foundation; and Gates Philanthropy Partners (funded with support from the Chan Zuckerberg Foundation); and travel support from the 2022 Nordic Dairy Congress.

SSY2-5

Reducing population salt intake in the WHO South- East Asia Region; Developing regional sodium targets and progress on other actions.

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The 11 countries of WHO South-East Asia (WHO SEA) Region are undergoing vast health challenges in terms of noncommunicable diseases (NCDs). Hypertension and cardiovascular diseases (CVDs) account for a large proportion of morbidity and mortality attributed to NCDs.

Dietary salt intake, a key risk factor for hypertension far exceeds WHO recommendations. A modeling exercise across WHO SEA countries reported that doubling the proportion of population currently consuming ≦ 5 g salt/d (30%) will reduce associated CVD mortality by ≧ 4 deaths/100000 population. WHO advocated the implementation of the WHO SHAKE package to progress towards the global goal of 30% reduction in salt/sodium intake by 2025 and is providing technical support to countries for salt/sodium surveillance, labelling and marketing of foods, education to consume less salt and healthy settings. The results are encouraging; all countries have set timebound targets to reduce mean population salt/sodium intake, six countries have implemented national behaviour change campaigns to reduce discretionary salt, and three have implemented front-of-pack labelling with a fourth country finalizing draft regulations. Food procurement in public institutions and settings based actions are also implemented. While discretionary salt dominates, consumption through foods supplied by food manufacturers is increasing. Countries are therefore planning to set sodium benchmarks to encourage industry reformulation of foods to a lower sodium content.

WHO's Global sodium benchmarks are mostly based on data/thresholds from high income countries. No benchmarks were available from WHO SEA to contribute to the global report. While global benchmarks are useful and can be adopted for some foods, the regional/country context, food consumption patterns and the level of salt/sodium in foods will influence country adaptation. An initial scoping identified issues that would be best addressed through adopting the global sodium benchmarks where relevant and setting new regional benchmarks for some food groups. These included varied food consumption patterns, food groups specific to SEA Region, particular foods contributing significantly to salt/sodium intake, foods with very high levels of salt, and food technology concerns of microbial safety and stability considering climactic conditions.

Therefore, country information on dietary habits, salt/sodium content of foods, top food contributors of salt and market availability of products are being utilized to inform development of regional benchmarks, at present in early drafting stage. Six major food categories, aligned to food categories in the WHO SEA Region nutrient profile model to better facilitate regulatory processes are planned, and 46 sub-categories. The benchmarks will be set at the lowest maximum value for each sub-category. Interim benchmarks will be provided for selected foods/sub-categories with very high levels of sodium, to encourage gradual lowering of sodium. Simultaneously, WHO is supporting capacity building on monitoring food reformulation and other regulatory actions to promote healthy diets through an e-learning course. WHO is also offering technical assistance to countries interested in taking initial steps to reformulate products. A digital scorecard to assess and advocate country progress toward the global target of 30% reduction in salt/sodium intake by 2025 is also finalized and will help countries easily visualize their status on salt reduction.

Keywords: South-East Asia, Salt, Reformulation

Conflict of Interest Disclosure: None

SSY3

Indigenous Peoples' food systems: How they cover Indigenous Peoples' dietary needs and can help broaden the current food base.

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1. Food and Agriculture Organization of the United Nations (Italy)

The Global-Hub on Indigenous Peoples' Food Systems is a knowledge platform that brings together Indigenous and non-Indigenous experts who co-create knowledge and share evidence on the sustainability and resilience of Indigenous Peoples' food systems. On the occasion of the United Nations Food Systems Summit in 2021, the Global-Hub coordinated the drafting of the collective White/Wiphala paper on Indigenous Peoples' food systems. The paper was accepted by the Scientific Group of the Summit and led to the recognition of Indigenous Peoples' food systems as game-changers. It hence played a fundamental role in the creation of the Coalition on Indigenous Peoples' food systems as major outcome of the Summit.

The White/Wiphala paper highlighted how Indigenous Peoples can make use of several hundred species of edible and nutritious flora and fauna found in their territories. This impressive inter- and intra- specific diversity is the result of centuries of territorial management practices that support the natural capacity of ecosystems to generate food while maintaining biodiversity. Those practices are rooted in their unique knowledge systems, values, language, and cosmogony.

Research carried out by Global-Hub's members have exemplified in several occasions the positive interlinkages between Indigenous Peoples' food systems, territorial management, biodiversity, food and nutrition security, and resilience. These results show in which measure the world has lot to learn from Indigenous Peoples and their sustainable approach to nature and territorial management.

In addition, the nutritional content of Indigenous Peoples' foods can contrast drastically with many other food commodities consumed worldwide. Food composition analysis of identical species can reveal high nutrient ratio within Indigenous foods compared to non-Indigenous foods. Moreover, 3 crops cover more than half of the humanity's energy intake. Indigenous Peoples' foods could hence help broaden the existing narrow food base, as long as free, prior and informed consent and Indigenous Peoples' intellectual property rights are respected.

As Indigenous Peoples can inform the global debate on sustainable food systems and sustainable diets as well as broadening the narrow food base (Opening remarks, Presentation 1), their food systems support their health and well-being (Presentation 2) in the meantime. Indigenous Peoples' knowledge systems ensure the positive interlinkages between sustainable management of the resources, nutrition and food preparation (Presentations 3, 4 and 5). This evidence contribute to the overall learning, preservation and promotion of Indigenous Peoples' food systems in research and policy-making, as well as to the Coalition's work.

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Conflict of Interest Disclosure: None

SSY4-1

Current status and challenges of under- and post-graduate education for registered dietitians in Japan: Toward a better future.

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The purpose of this presentation is to introduce the current status and challenges of under- and post-graduate education for registered dietitians (RDs) in Japan.

In Japan, approximately 10,000 people pass the national examination and obtain RD license each year. More than 90% (8,812, in 2021) of those who pass the exam are new graduates of four-year RD training facilities (n=152), many of which are universities (n=144).

One of the characteristics of RDs in Japan is the diversity of workplaces. The common places of employment for new graduates are hospitals (34%), companies (26%), food service companies (13%), long-term care insurance facilities (10%), child (6%) and social welfare facilities (4%), schools (3%), and governments (3%) (March 2022). The reason of such diversity is that Japan's dietitian system began at a time of worsening nutritional conditions at the end of World War II. The government established the status and duties of dietitians in the Dietitians Law and Nutrition Improvement Low, which mandated the assignment of dietitians to specific facilities, such as, schools, hospitals, and welfare facilities.

With the subsequent economic growth and the rapid aging of the population, the purpose of improving nutrition changed from malnutrition to prevention of lifestyle-related diseases, requiring the ability to manage within the health, medical care, welfare, and nursing care systems. In other words, the work of RD s has become more focused on addressing the "human itself", the individual's physical condition and nutritional status.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Therefore, education that fosters comprehensive competence in knowledge, skills, and attitudes to cover the diverse areas of expertise that RDs must fulfill has become a requirement. Revisions to relevant laws, educational content, and the national examination guidelines, as well as the creation of a model core curriculum and a competency model have been developed up to the present.

Regarding post-graduate education, since the RD license is not renewable, education to maintain professional knowledge and practical skills is necessary. In Japan, the Japan Dietetic Association (JDA) is responsible for this role. The JDA provide some educational programs and approve "Authorized RD/ Dietitian" in the8 areas and “Specially Certifies for RD/Dietitian” in the 5 specific fields (specialized health guidance, home-visiting, food allergy, parenteral and enteral nutrition, and certified sports nutrition). Moreover, under the commission of the Ministry of Health, Labour and Welfare, the "Certified Specialist of RD by Specialty Field" program is conducted in collaboration with related academic societies in the 5 fields: cancer, kidney disease, diabetes, dysphagia rehabilitation, and home nutrition management.

There are many issues in RD education. As for under-graduate education, a shorter period of super-vised professional practice has been conducted than those of foreign countries, and the priority of education is tended to be placed on passing the national examination rather than acquisition of higher level of professional knowledge and skills. As for post-graduate education, only Japanese dietitians (approximately 50,000) are eligible for this program, so it is desirable to enhance recurrent education at the university. Finally, with the development of digital transformation and AI technologies, RDs will be required to manage more personalized nutrition care and to create healthy food environments. The RD education may enter a new stage.

Keywords: Registered dietitian, education, national examination, competency, professionalization

Conflict of Interest Disclosure: None

SSY4-2

Korean Dietitian Education from the Perspective of the Dietitian Licensing Examination

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1. Korea Health Personnel Licensing Examination Institute (Korea)

As of December 2021, 167,307 people had been licensed as dietitian in Korea and 42,107 dietitians were working at the various sites. 87% of them were working at food service industry and 13% were working in such areas as education or research on food and nutrition. Korea's Dietitian education began in 1929 by establishing the department of Home-Economics in Ewha Woman's University and teaching a science-based nutrition. In Korea, “Dietitian” was first named to the hospital meal managers in 1950 who had graduated from the department of Home-Economics.

Then the dietitian licensing system was adopted in 1962 when [Food Sanitation Act] was activated. Since 1978, it has been necessary to pass a government-managing licensing exam to obtain a dietitian license. At that time, the Ministry of Health and Welfare organized the exam, and 868 people passed and received dietitian licenses at the first year. Later, since 1998, the dietitian licensing exam has been conducted by Korea Health Personnel Licensing Examination Institute (KHPLEI, hereinafter referred as Kuksiwon). Kuksiwon is the public institution in charge of all licensing exam for healthcare professionals including doctors, nurses, and dietitian etc.

The purpose of the dietitian licensing exam set by Kuksiwon is to evaluate whether they have a job competency as dietitians. The dietitian licensing exam is being conducted as a Paper Based Test consisting of multiple choices questions. The Kuksiwon is trying to secure the validity of the questions and the reliability of the evaluation results. To increase the job relevance with the exam, Kuksiwon leads job analysis of the dietitian and keeps improving the exam subjects based on the results from the research. In addition, Kuksiwon is steadily conducting researches on appropriate evaluation method.

As the healthcare environment changes rapidly, and food and nutrition related information overflows, it gets more difficult to people to find the exact information they need to improve their health and apply to their dietary life. In hence, the roles of dietitians demanded by society are expanding from the traditional role of food service provider to the sophisticated role of customized nutritional information provider. Furthermore, the dietitians should be the ones who teach and lead people how to take care of dietary life themselves, just like personal trainers.

Therefore, In the dietitian education, the direction of this change and society's specific requirements should be accurately grasped and reflected. In licensing exam, it is strongly important to discover and evaluate the effective core job competencies, which are also valid in future.

Keywords: Core Job Competencies, Dietitian Education, Dietitian Licensing Examination

SSY4-3

U.S. Food and Nutrition Practice in the Time of Discovery and Disruption

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The food and nutrition profession in the United States, which includes nutritionists, Registered Dietitians and nutrition educators, continues to show strong job growth and opportunities. It is an exciting time to practice within the field of food and nutrition that is seeing new research and technology expand our practice in new areas and yet, there has never been a more challenging time. This is an exciting time of discovery that

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

increasingly integrates new research and innovative technology that is changing our ability to monitor personal health and inform clinical practice. New research in genomics is increasing our ability to provide personalized nutrition that will integrate individualized healthy eating plans and personal genomes. Our increasing knowledge of human microbiomes as moderators of health and the role of chronic inflammation in the etiology of many of chronic diseases such as cardiovascular diseases, diabetes and some cancers reinforce and refine our long-standing recommendations for healthy eating patterns based on a variety of whole foods or minimally processed foods. U.S. health professionals are now recognizing what nutritionists and dietitians have long known-Food is Medicine. Longevity science and system science is challenging our approach to individual physical health independent of mental, emotional and social health or persons independent of families, community and the planet. Our excitement and enthusiasm for new knowledge and understanding of the human health and the role of food and nutrition in maintaining well-being across the lifespan is challenged by the global syndemic of obesity, undernutrition and climate change. Human activity on the planet is dismantling ecosystems with increasing rapidity. The disruptions of the pandemic, wildfires, drought and hurricanes within the U.S. and the concomitant social, economic and physical challenges have disproportionately affected the vulnerable populations. We have yet to address the social determinants of health that divide our nation and impact our practice. Emergency food systems such as food pantries have become permanent and expanding programs in communities, including schools. Overweight and obesity is rising in all age groups and chronic disease is occurring at younger ages. It is our challenge to support the people in our programs, provide the food and nutrition guidance to improve individual lives but also consider that since the 1970s we have created a society of increasingly unhealthy people and have yet to understand this from a system level. Progress has come at a cost and we have yet to unravel the mistaken directions in science or practice that have contributed to our declining longevity, increased chronic disease burden and environmental deterioration. Our profession is uniquely placed at the intersection of the food system and health system and we must discover new approaches in our practice to meet the disruptions.

Keywords: Genomics, microbiome, social determinants of health, climate change, longevity

Conflict of Interest Disclosure: None

Further Collaborators: None

SSY5-1

3D Food Printing Technology in Sustainable Food and Nutrition Security

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Presently we have faced with many world-wide difficulties, such as an aging and declining population, extreme natural disasters, and global climate change. These issues should be addressed and resolved by science and technology so that we may bring a better future to our society. Against this background, Council for Science, Technology and Innovation of Japan has recently started the new "Moonshot Research and Development Program" aiming to create disruptive innovations and promoting challenging R&D based on revolutionary concepts that are not simply the extension of existing technologies. To realize "Human Well-being", nine Moonshot goals have been decided in the area of society, environment, and economics. The Bio-oriented Technology Research Advancement Institution has started the Moonshot Agriculture, Forestry and Fisheries Research and Development Program to realize the research and development concept, which was set forth by the Ministry of Agriculture, Forestry and Fisheries, Japan to achieve the Moonshot Goal #5 "Creation of the industry that enables sustainable global food supply by exploiting unused biological resources by 2050" decided by the Council for Science, Technology and Innovation. In order to realize the creation of a sustainable food supply industry on a global scale in 2050, it is essential to utilize food loss so that approximately 10 billion individuals, including an increasing number of 2 billion people, can consume food satisfactorily. We have proposed "Development of Innovative Food Solution for Simultaneous Food Loss Reduction and QoL Improvement". Our project is expected to build an innovative solution system that provides tasty/healthy personal foods suitable for each individual using AI-driven 3D printing system to reduce food loss and improve food QoL at the same time, in which we will produce long-term preservable food cartridges for 3D printers from food loss.

Keywords: 3D Food Printing Technology, Personal Food Production, AI-3D Chef Machine, Food Loss Reduction

Conflict of Interest Disclosure: The research is supported by Bio-oriented Technology Research Advancement Institution, Japan.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SSY5-2

Bridging Nutrition and Food Science

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There are no disciplines so encompassing in human activities as Nutrition and Food Science and no factor more to human survival than food. What are the properties of food and how best can they be used to serve the needs of the body? These are the factors that characterize Nutrition and Food Science as a Science. Food Science and Nutrition is the Science behind the food we eat. From the effect food has on our behavior and wellbeing, to its new applications in food development, processing, compliance, and food safety. While Food Science focuses on manufacturing, processing and production of food, Nutrition science focuses on the maintenance of good health and wellbeing of populations. As disciplines, Nutrition and Food Science answer questions and solve problems. The questions and problems are diverse in nature and cover the spectrum of issues and are interrelated in making the world feeds itself and tomorrow (Ref. FAO's preamble in its constitution, ICN (1992) and World Food, Food Systems Summits (1996-2021), Millennium and Sustainable Development Goals and other international efforts look to Food Science and Nutrition to provide the solution. Both as may be said to include basic science of chemistry, biochemistry and microbiology just to mention a few. Microbiology of food, is less well known to the average scientist where as Food Science or more precisely the utilization of food materials and the study of the composition of food materials (the different varieties of the same Food based on genomic information) and the reaction of food to processing, cooking, packaging and storage not considered. It integrates the knowledge of the chemical composition; their physical, biological and biochemical behaviour; its interaction of food components with others (water) and their environment; pharmacology and toxicology of food materials, additives, and contaminants and the effects of manufacturing operations, processes and storage conditions. Limiting Food Science to utilization of food products alone, would be restricting its usefulness; ideally, it should serve as a support to Nutrition at its early stage. Over the past decades, the identification of vitamins and other essential nutrients and the development of appropriate Food Science and Technology, led to the fortification and thus to the modification of food to better suit and fulfill specific needs through the development and production of new nutritious foods to improve the diets of people and specific groups and to the abundance of high density, cheap calorie sources, coupled with market competition that has also facilitated overconsumption and promoted diseases of affluence such as obesity. Also, as a result, nutritional deficiencies have been drastically reduced or even eradicated. By also, carefully studying the chemical complexities of foods, their vulnerability to spoilage, their disease vectors, and varying sources of production. Food Scientists endeavor to accomplish this formidable task. To solution some nutritional deficiencies Food Science and Nutrition produced protein rich food , enriched low proteins food, guaranteed adequate sanitation and hygiene , and in addition, ensured fair trade, availability of essentials foods at all times and all seasons, increased revenue to the producer and development of food manufacturing industries to utilize local raw materials and establishment of food industries in rural areas and production centers for raw materials. The above points are extremely pertinent to show that the gap between Nutrition and Food Science can be bridged.

Keywords: Food Science, Nutrition, Discipline and Bridge

SSY5-3

Role of Tradition & Food for Better Health

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1. CIFST (China)

A couple of tests were carried out to reveal the uncertain but critical role of food's antioxidant activity in metabolism regulation. Fasting test was conducted on human subjects for 5 days, in which each subject was provided with 200 ml water daily without any food. Meanwhile, TAT-SOD, an intracellular superoxide neutralizing enzyme was topically applied to 4 acupoints around the stomach and two acupoints above the ankles of the subject with daily change. The serum glucose content and muscle glycogen content were determined twice a day. As a result, the muscle glycogen steadily decreased while the serum glucose content remained around 6 mM, indicating that utilization of glycogen could possibly regulated by superoxide content which was decreased through the topical application of TAT-SOD at acupoints. To confirm the association between the superoxide level with glucose metabolism, a fasting as carried out on mice, Mice were divided into water and TAT-SOD groups and fed with only water and 3000u TAT-SOD/ml solution, respectively, Ten mice in the water group all died and the body weight decreased from 12 g to 4 g each, while mice in TAT-SOD group survived two more days with a body weight of 8 g at death, The enormous regulating power of quantitatively insignificant TAT-SOD enzyme indicates that antioxidant activity of food is obviously an important mechanism how food directly regulates body. Delivery of the antioxidant activity either by topical application at acupoints or alimentary intake through drink all demonstrated significant impacts, Whether antioxidant activity should be the most important attribute of food in addition to nutrients and energy may take years or decades to establish, but it must have been the hidden principles behind countless traditional wisdoms and practices of utilizing food to maintain health and wellness considering the striking regulating power revealed in our simple tests. Elucidation of how antioxidant activity in traditional food, herbs, fermented food regulate body metabolism will eventually make the dream come true that food is your medicine.

Keywords: Superoxide, food, antioxidant, metabolism, regulation

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SSY5-4

Interfacing the Science of Food, Nutritionals, and Nutraceuticals for delivering Safe and Sustainable Healthy Food Products to the consumer

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Understanding the role of nutrition, nutraceuticals, and supplements in the context of Innovations in Food Science for a healthy diet is emerging fast. precision nutrition and a healthy lifestyle are becoming important, especially with exciting developments that have happened in the last decade where nutrition scientists and food scientists have joined hands to put in the market, products that the consumer needs for a healthy diet and healthy lifestyle. It is important to note the emergence of nutrigenomics with a deep understanding of traditional foods for better health emphasizing the concept of holistic nutrition. This is further enhanced in its approach of using the basic chemistry of Nutritionals and nutraceuticals which helps in expanding the combinatorial chemistry knowledge at the molecular level coupled with traditional wisdom and practice. It is this functional aspect that will be focused in the talk citing epidemiological evidence and webbing the science-based knowledge to provide safe and nutritious food. Such foods when enriched with needed nutrients and nutraceuticals to manage food-based nutrition and health occupy an important position in the daily diet of course need to be affordable. The scope of Nutritionals and nutraceuticals on the platform of Food Science and Technology as an integrated system is important to understand. The fundamental role of bioactive molecules and their functional attributes in the realm of functional foods cannot be undermined either. The current scientific data encourages one to look at the cross-functionality and core functionality of foods with a focus on ingredients, combinatorial chemistry, and understanding the bioavailability of the desired molecules in the context of the gut microbiome. For futuristic thinking of healthy diets and personalized nutrition, a flexible approach of understanding local problems paving way for nutritional maladies can be achieved with nutritionists working closely with food scientists and vice versa for a science-based and evidence-based knowledge networking with local solutions for global problems.

Keywords: Nutritionals, nutraceuticals, nutrigenomics, food science, integrated health management, healthy diet, supplements, traditional knowledge, ethnic foods.

Conflict of Interest Disclosure: None

Further Collaborators: None

SSY6-1

Combating Obesity in Emerging Economies: Malaysian Perspective

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Malaysia's sustained economic growth and political stability over the last five decades has brought about rapid demographic and nutrition transition which has inevitably generated marked changes in dietary habits and life styles of Malaysian. The “fat - sugar laden” local dishes and the “westernization” of global eating habits, made possible through food imports, fast foods and 24 hours food outlets has led to a rising consumption of fats and sugars coupled with, sedentary lifestyle are largely responsible for the rising epidemic of obesity and associated diseases. The epidemiology of obesity based on population estimates of BMI is very disturbing judging from the rapid increase in prevalence of overweight and obesity in both adults and children. The National Health and Morbidity Survey (NHMS) in Malaysia reported that the overall national prevalence of overweight and obesity in adults was 44.5%, 47.7% and 50.1% in 2011, 2015 and 2019, respectively. The NHMS (2019) reported 14.8% of children 5 to 17 years of age are obese, an increase from 2011 (6.1%) and 11.9% in the 2015 survey in children below 18 years old. It is also becoming more apparent that the traditional approach appears to have failed in producing the desired effect judging from the increasing trend in prevalence of obesity within the last decades. With modest weight gain, Malaysians are known to be susceptible to enhanced co-morbidities. An EIU study (2017) reported total cost of obesity estimated to be between 10% and 19% of national healthcare spending. Preventive strategies both short and long term has been developed within the national action plan that requires commitment by all stakeholders. Unless we could make policy makers, professionals, private sectors and the population at large understand the threat obesity poses and the urgency to implement possible solutions now, the natural course would be an obesity epidemic that will continue to grow beyond our control in the coming decades. This paper will highlight the prevalence and trends, issues related to the problem, efforts made to curb them and the current challenges that we faced in Malaysia.

Keywords: Obesity, Emerging Economies, Combating, Malaysia.

Conflict of Interest Disclosure: None

SSY6-2

Inflammation, Immunity and Cardiometabolic Syndrome

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1. EcoNugenics (USA)

Cardiometabolic Syndrome (CMS) remains one of the leading causes of morbidity and mortality in Western and other countries. Recent evidence shows that dysregulation of the immune system and inflammatory pathways play a pivotal role in CMS. Oxidative stress can damage practically all larger biomolecules in the cell, such as membrane lipids, proteins, and DNA. This will cause pathologically relevant oxidative stress and serious metabolic dysfunctions such as lipid peroxidation and arteriosclerosis. Immunity-related cell types and cytokines may contribute to different physiological and pathological responses in maintaining metabolic homeostasis and the healing process. Innate and adaptive immune responses mediate neuroendocrine disturbance and vascular inflammation leading to CMS. Phytonutrients known to affect immunity and infection risk, anti-inflammatory, and antioxidant capacity nutrients particularly relevant to cardiometabolic syndrome will be discussed. More research in this emerging area is warranted.

Keywords: Cardiometabolic syndrome, Immunity, Inflammation, Oxidative stress, Phytonutrients

Conflict of Interest Disclosure: Employee of EcoNugenics

Further Collaborators: None

SSY6-3

Biofortification: Future Challenges for a Newly Emerging Technology

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1. HarvestPlus (Philippines)

In October 2002, the donors to the Consultative Group on International Agricultural Research (CGIAR) approved funding for the "Biofortification Challenge Program," later renamed HarvestPlus. In the early years, there was a great deal of skepticism in the nutrition and agricultural communities that biofortification would work. Twenty years later, what challenges lie ahead? Global agricultural strategies take far longer than two decades to implement. Initial crop development before the first biofortified crop releases took 8-10 years. Because of the nature of exponential growth of adoption of new crop varieties, most impact is realized on the back-end of investments. Indeed, although agricultural strategies are low cost and highly sustainable over the long-term, policymakers and donors often take a short-term perspective. HarvestPlus was the first, and remains the only, initiative to implement biofortification across several staple food crops on a global scale. From the start, biofortification focused on iron, zinc, and provitamin A—three nutrients critical to health and development, yet among those most lacking in diets globally. More than 400 high-yielding biofortified crop varieties have been released in forty countries and are in testing for release in over twenty more. The challenge is now to expand uptake in these countries to the hundreds of millions of consumers. For example, a zinc wheat variety released in Pakistan in 2019 (named Akbar-19) is poised to become the latest mega-variety, accounting for approximately 50% of wheat production in the country. In the current crop year, Akbar-19 accounts for nearly 50% of all certified wheat seed production. Its popularity derives from high yield, tolerance to heat, and resistance to constantly evolving plant viruses. For the average consumer with a daily wheat intake of 300 grams, substituting Akbar 19 one-for-one for non-biofortified wheat provides about 4 milligrams of additional zinc a day to diets—at no extra cost to consumers and no extra public investment. Although benefit-cost ratios are quite high, adding single nutrients to specific crops only scratches the surface of the full potential of biofortification. Food staples provide a high percentage of a wide range of minerals, vitamins, and other nutrients in the diets of the poor. Multiplying the food staple amount times a relatively low nutrient density, gives significant absolute levels of intake. Advanced agricultural crop development techniques offer the possibility of simultaneously adding multiple climate-smart and nutrition-smart characteristics to future food staple crops produced and consumed in low- and middle-income countries. There is now substantial evidence establishing nutritional efficacy and improvement in functional outcomes for all three nutrients in biofortified foods. In selected countries, there has been significant adoption and consumption of biofortified crops, demonstrating "proof of concept" that biofortification works. Biofortification has become a recognized strategy, among several others, that policymakers may apply to address hidden hunger. It is essential at this critical juncture of expanding impact that public and private agricultural research entities continue to develop an expanding pipeline of ever-more-dense and high-yielding biofortified crops, and for public and other agencies to expand promotion of uptake of biofortified crops.

Keywords: Biofortification, Micronutrient, Malnutrition, Agriculture, Staples

Conflict of Interest Disclosure: None

SSY7-1

Food and Beverage Marketing to Children: An Overview of the Landscape

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The marketing of unhealthy foods and non-alcoholic beverages (hereafter: food) has been strongly implicated in the rising levels of childhood obesity worldwide. Contemporary syntheses of research evidence show that unhealthy food marketing remains highly prevalent globally, particularly across media and settings of interest to young people (including television, digital media,

packaging, and outdoors), and predominantly promotes foods that contribute to unhealthy diets (such as fast food and sugar-sweetened beverages). This marketing has considerable persuasive power, using a range of creative strategies likely to appeal to, and resonate with, young audiences including celebrity endorsements, promotional characters, branding, and dynamic animations. There is considerable evidence that exposure to powerful food marketing messages affects the behavioural antecedents (norms, beliefs, attitudes) that underpin children's and adolescents' food behaviours. For example, positive associations have been found between young people's exposure to unhealthy food marketing and their descriptive norms about these foods. There is also robust evidence that young people's actual food behaviours are impacted by unhealthy food marketing. Specifically, this marketing is associated with increased intake, choice, preference and purchase requests in children and adolescents. However, there is a lack of research on impacts of food marketing on downstream health outcomes such as dental health and body weight. Given this evidence of impact, and with diet-related non-communicable disease risk and obesity prevention in children being public health priorities in many countries globally, best-practice recommendations have been issued by the World Health Organization (WHO) and other authoritative bodies for the restriction of unhealthy food marketing to children. Implementation of WHO recommendations has been inconsistent with a lack of comprehensive approaches, but some countries have enacted mandatory policies and some food industry groups have established self-regulatory programs that refer to encouraging more “responsible advertising”. An evaluation of these policies indicates that they can effectively reduce unhealthy food marketing exposure, power, and marketing spend, and may result in reduced purchases of unhealthy foods by, or on behalf of, children and adolescents. Few studies have explored the impact of policies on outcomes such as dietary intake or product change (e.g., reformulation). Policies including certain design elements, such as mandatory implementation and the use of a nutrient profile model, were more likely to be evaluated as effective. Children and young people are considered particularly vulnerable to food marketing messages by virtue of their cognitive and developmental immaturity that means they are less likely to recognise marketing messages or their selling and persuasive intent. Unhealthy food marketing is also said to affect numerous child rights enshrined within the UN Convention on the Rights of the Child including the right to the enjoyment of the highest attainable standard of health, the right to adequate food, and the right to privacy. Effective regulation of children's exposure to this marketing and its persuasive power is a key public health challenge to which States must rise.

Keywords: Food marketing, children, adolescents, impact, policy

Conflict of Interest Disclosure: None

SSY7-2

WHO guideline to protect children from the harmful impact of food marketing

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In accordance with the Organization-wide transformation in strengthening WHO's role in developing evidence-informed public health guidance, the Department of Nutrition and Food Safety (NFS) has strengthened its role and leadership in providing evidence-informed policy and programme guidance to Member States for promoting healthy diets and nutrition throughout the lifecourse, in partnership with relevant internal departments and partners, and guided by the new WHO guideline development process. To implement the strengthening of evidence-informed nutrition guidance, NFS established the WHO Nutrition Guidance Expert Advisory Group (NUGAG), its members representing all WHO Regions. To provide evidence-informed WHO guidance on effective policy measures to support Member States in developing an enabling food environment to promote healthy diets and nutrition, NFS established the ***WHO Nutrition Guidance Expert Advisory Group (NUGAG) Subgroup on Policy Actions*** in 2018. Since the Subgroup was established, it has worked on food environment policy guidelines related to school food and nutrition policies, fiscal policies to promote healthy diets, policies to protect children from the harmful impact of food marketing and nutrition labelling policies, and work on menu labelling policies is being initiated. This presentation will be on the WHO guideline on policies to protect children from the harmful impact of food marketing, which provides recommendations on measures to restrict food marketing to which children are exposed, including on policy design elements to improve the measures' effectiveness. Since the WHO Set of Recommendations on Marketing of Foods and Nonalcoholic Beverages to Children were endorsed at the Sixty-third World Health Assembly in 2010, the evidence base on the extent, nature and impact of food marketing on children has grown, with increasing recognition given to food marketing as a children's right concern. Despite numerous subsequent calls for action and the growing evidence on the harmful impact of food marketing on children, little progress has been made to protect all children. In response to Member State requests, and to strengthen and streamline support for Member States in developing and implementing new, or strengthening existing, policies to protect children from the harmful impact of food marketing, WHO began the process of developing this guideline. This presentation will provide information about the guideline development process and the guideline's content.

Keywords: Food marketing, Children, Rights, Guideline

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SSY7-3

New Developments in Food and Beverage Marketing to Children: Upcoming issue – digital marketing

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1. World Health Organization (Denmark), 2. World Health Organization (Switzerland)

Children are a vulnerable population group and need special protection from environments that harm their physical or mental health. A healthy diet and adequate nutrition is important throughout the life course, starting even before birth with the mother's nutrition of a child. Very early on in life children are exposed to various kinds of marketing including the marketing of unhealthy products which can influence their perception, preferences and choices. Marketing techniques become more personalized and technical making them even more effective and persuasive. The WHO set of recommendations point out the need to address cross boarder marketing within the region. Other concerning and rather emerging concerns are the promotion of brands rather than products. In the context of HFSS marketing, this means that nutrient profile models cannot be used anymore to objectively differentiate between products permitted and the ones that are prohibited to be marketed to children. Also new social media platforms, streaming services and games which include marketing have to be considered in new interventions.

The WHO European Office for the Prevention and Control of NCDs is working on three main workstreams to support Member States with the implementation of effective measures protecting children from harmful advertisement. Mapping of national contexts, the understanding of marketing ecosystem, main stakeholders and existing marketing related regulations is an important step to build a baseline which can lead to a successful implementation of interventions.

The monitoring of traditional and digital marketing is not only for countries with existing regulations essential to evaluate the effectiveness of the legislation but also for countries who have no legal framework in place yet to protect children from harmful marketing. The monitoring data can raise awareness, show the need for regulation and highlights the media platforms where children are exposed the most. The WHO CLICK monitoring framework was developed by the NCD office in 2018 and was piloted by Member States. The pilot studies were focusing on the monitoring of unhealthy foods and drinks (HFSS products). The framework will be used for the monitoring of tobacco, alcohol and other unhealthy products to children and is also adapted for BMS marketing for early mothers.

The WHO NCD Office developed an application which can capture all forms of marketing by taking screenshots of pre-defined apps. An artificial intelligence tool supports the evaluation of the collected data. The new tools are currently piloted and validated. Only very few countries have already implemented strong legislations restricting marketing of unhealthy products to children. It is essential to learn from their experiences through regular meetings and support other countries with the development strong legal frameworks. It is important to understand how marketing restrictions can be implemented in existing laws or how a new law can be built.

Keywords: Marketing, digital marketing, CLICK, marketing monitoring, unhealthy foods and beverages marketing

SSY7-4

New development – the Nutrient and Promotion Profile Model (NPPM) background

Holly Rippin[1]

1. World Health Organization (Denmark)

Globally, countries continue to struggle with high rates of childhood obesity. There is overwhelming evidence that the marketing of foods and beverages high in saturated fat, trans fat, free sugars or salt influences a child's food preferences. Increasing consumption of these promoted products high in saturated fat, trans fat, free sugars or salt, is associated with increased risk of overweight, obesity and diet-related noncommunicable diseases (NCD). Overweight and obesity in childhood can profoundly affect children's health, with negative consequences for physical, mental and social well-being. Childhood obesity is also a risk factor for developing NCDs later in life, many of which are preventable. Marketing of unhealthy products is linked to children's food preferences, requests, purchases and eating behaviours, and therefore to childhood obesity. The World Health Organization (WHO) has developed a guideline on policies to protect children from the harmful impact of food marketing. This provides recommendations on measures to restrict food marketing to which children are exposed, including on policy design elements to improve the measures' effectiveness. The WHO Regional Office for Europe has been spearheading work on regulating children's exposure to digital marketing. Realizing the need for monitoring across countries to gain credible data, the WHO Regional Office for Europe has developed the CLICK monitoring framework, which is comprehensive, flexible, and is being used by several Member States. From the start of a child's weaning journey, many commercial food products for infants and young children are inappropriate, exposing this vulnerable group to foods that disregard public health recommendations. Concerns with commercially produced foods for infants and young children are seldom tackled by legislation and include: i) high total sugars contents with large amounts of free sugars increasing their sweetness; ii) marketing from 4 months of age, despite WHO guidance to exclusively breastfeed to 6 months; iii) pervasive use of nutrient, health and marketing claims. WHO have also developed a Nutrient & Promotion Profile Model (NPPM) with an accompanying toolkit and online platform for restricting the marketing of inappropriate foods for infants and children aged under 3 years. The NPPM aims to support countries in identifying inappropriate foods for infants and young children, engage with stakeholders to raise awareness, and effect policy and legislative change to support optimum nutrition and reduce NCD risks in later life. The NPPM and toolkit will help build capacity in

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

countries to enable them to ensure products align with health and nutrition goals by evaluating suitability and supporting policy change. The session will present the underlying issues in addressing the marketing of food and non-alcoholic beverage products to children of all ages. It will provide an overview of the landscape and delve deeper into upcoming issues, focusing on digital marketing and the work WHO is doing in this space. It will also present the groundbreaking new NPPM, its composition and promotional requirements and demonstrate the toolkit resources and how these will help countries apply the NPPM. A live online tool demonstration will display how countries may quickly and practically assess and monitor product suitability.

Keywords: Digital marketing, Foods for infants and young children, Nutrient profiling, Childhood obesity, Noncommunicable diseases

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SSY7-5

New development – the Nutrient and Promotion Profile Model (NPPM) in practise

Janet Cade[1], Victoria Jenneson[1]

1. Leeds CC (UK)

The first draft Nutrient Profile Model for commercially available complementary foods for infants was developed for WHO in 2019. The aim was to drive changes to product composition, labelling and promotion practices in the WHO European Region. We trialled the model with 10 countries across Europe (involving 2634 baby food products) and obtained feedback from key informants. Following this, we refined the categories and nutrient thresholds for ease of use. The model was simplified through clarification of specific food categories. Nutrient requirements by food category were made clearer and promotion/labelling specifications applied to all categories. The final model was renamed the Nutrient and *Promotion* Profile Model (NPPM) to include the importance of appropriate marketing. The final model has 8 product categories: dry cereals/starches; dairy foods; fruit and vegetable purees/smoothies and fruit desserts; savoury meals/meal components; snacks and finger foods; ingredients; confectionery; drinks. The nutrient and ingredient requirements provide guidance on not permitted items such as free sugars/sweeteners, confectionery and flavoured drinks; limiting the fruit content in meals, dry cereals and dairy products; setting maximum levels for energy, sodium and total fat and minimum standards for protein content in meals and energy density. Promotional requirements refer to the age for product consumption (minimum age 6 months). The product name should be clear and indicate contents in descending order, not hiding sweet taste or high fruit content. The ingredients list must state the amount of added water/stock, fruit content and the amount of traditional protein source. Packaging with a spout should note this is not suitable for drinking. Statements on packaging should highlight the importance of continued breastfeeding. Pilot testing of the new model in Turkey on 224 baby foods showed that less than a third of products passed the compositional requirements and all products failed the NPPM promotional requirements. This is in part due to Turkish law allowing health related statements on packaging. Working with stakeholders, we plan to disseminate the tool among key audiences across Europe and beyond to influence policy and support legislation and market change.

This seminar will include a 'hands on' demonstration of a new website which includes a NPPM calculator to assess how baby food products perform. You will be able to try the website and calculator to assess compliance of baby foods to the standards.

Keywords: baby food, nutrient and promotion profile model, world health organization, website, calculator

Conflict of Interest Disclosure: J Cade is a Director of Dietary Assessment Ltd. She leads the WHO Collaborating Centre in Nutritional Epidemiology; V Jenneson works in partnership with a national UK retailer.

Further Collaborators: Dr Diane Threapleton and Ali Morpeth lead the creation of the new NPPM.

Dr Holly Rippin supported this work through her role as consultant for WHO.

Dr Jayne Hutchinson was involved in the original NPPM development.

Annals of Nutrition and Metabolism

Symposia

SY(T1)1-1

Unraveling gut-microbiome-brain interactions

Mauro Costa-Mattioli[1]

1. Baylor College of Medicine (USA)

When we think of behavior and neurological disorders, we think about the brain. Traditional research on the biology of neurological disorders has focused on the brain, aiming to identify key brain regions and circuits, relevant molecular mechanisms, and/or new genetic variants associated with brain disorders. Consequently, current therapeutic approaches for neurological disorders aim to target the brain directly. However, we are the bearers not only our own genomes, but also the genomes of the microbes living with us in symbiosis. As we now appreciate, symbiotic microbes are fundamental to nearly every aspect of host function and fitness. In my lab, we serendipitously discovered that specific microbes in the gut can modulate brain function and behaviors in an amazingly powerful way. In this presentation, I will focus on our more recent work that aims to dissect the signals, structures and mechanisms that regulate gut-microbiome-brain interactions. In addition, I will discuss how a selective non-invasive, microbial-based approach is beneficial in preclinical animal models or neurological dysfunction and more recently in humans. Our findings could not only provide a new holistic dimension of how behaviors and the brain are controlled by gut microbes, but they could also lead to the development of new non-invasive microbial-based therapies for neurological disorders.

Keywords: Microbiome, neuroscience, neurological disorders

SY(T1)1-2

Quantitative approach identifies metabolic underpinnings associated with schizophrenia

Takeo Yoshikawa[1]

1. RIKEN Center for Brain Science (Japan)

Mental disorders are diagnosed and classified based on the behavior and verbalized internal experiences of the subject, which is a spectrum in many dimensions. Mental disorders have characteristics specific to human, and it is not easy to lay them out in terms of model animals. However, it is natural to pose that the equivalent of the biological basis of psychiatric disorders also exists in mice, which can be approached by targeting "quantitative traits". The prepulse inhibition phenotype (quantitative trait) has the advantage in that it can be measured in the same paradigm in both humans and mice, and a reduction in PPI function has been reported in schizophrenia and other psychiatric disorders. We measured PPI in four inbred strains of mice and found that C57BL/6N (B6) had the best PPI (far from schizophrenia when translated to humans) and C3H/HeN (C3H) had the worst (close to schizophrenia) PPI. Quantitative trait loci (QTL) analysis was performed to determine the genetic basis for the differences in PPI function between B6 and C3H mice. As a result, *Fabp7*, which encodes a fatty acid chaperon molecule, was identified as a responsible candidate gene. We evaluated the association between *FABP7*, *Fabp7* and schizophrenia from various aspects in mice and humans. On the other hand, biological phenotypes are influenced by environmental factors, which include elements consistent with the concept of Developmental Origin of Health and Disease (DOHaD). Proteomic analysis of strain differences in the brains of the B6 and C3H mice revealed that the Mpst, which has a role in hydrogen sulfide production, was highly expressed in C3H mice compared to B6. The cause of the enhanced hydrogen sulfide production system was not due to genomic polymorphisms, but thought to stem from epigenetic changes. The functional consequences and its relationship to schizophrenia were examined. In this session, based on the above stated findings, I will illuminate some metabolic underpinnings of schizophrenia pathogenesis and pathophysiology.

Keywords: schizophrenia, quantitative trait loci analysis, fatty acid binding protein, hydrogen sulfide, epigenetics

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)1-3

Mechanisms underlying memory impairments by Vitamin B1 deficiency

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1. The University of Tokyo (Japan)

Vitamin B1 (thiamine) deficiency (TD) has known to induce cognitive dysfunction including deficits in memory formation known as Wernicke-Korsakoff's syndrome in human. However, mechanisms by which TD leads to deficits in learning and memory still remain unclear. In this study, to understand them, we examined effects of pyrithiamine-induced thiamine deficiency (PTD) on learning and memory in mice. PTD-treated mice showed comparable body weight and motor performance compared with control mice 3 weeks after PTD treatment. However, PTD-treated mice showed impairments in formations of social recognition, contextual fear, novel object recognition and spatial memories 3 weeks and 3 months after the PTD treatment, suggesting that the PTD-treatment led to chronic impairments in the formation of hippocampus-dependent memories. Importantly, anatomical analyses indicated that PTD-treated mice displayed significant decreases in sizes of hippocampus and spine density of hippocampal neurons. Our results indicated that PTD-treatment led to impairments in hippocampus-dependent memory and degeneration of hippocampal neurons, suggesting that PTD-treatment impairs the function of hippocampus. To understand molecular mechanisms of hippocampal degeneration by PTD, we performed RNA-seq analyses of hippocampus using next-generation sequencing. We found that PTD mice showed increases in expressions of inflammation-related genes in the hippocampus. Furthermore, PTD mice show impairments of neural activity dependent gene expression and significant decreases in mRNA expressions of transcription factor CREB in the hippocampus, suggesting that PTD showed impaired CREB signaling pathways in the hippocampus. Taken together, our findings suggest that PTD causes strong inflammation, thereby leading to hippocampal degeneration and subsequent impairments in CREB signaling pathways that play essential roles in memory formation. We finally examined effects of PTD on transgenic mice increasing the CREB activity by expressing a constitutively active CREB mutant in the forebrain (DIEDML mice, Suzuki et al 2011) and found that activation of CREB rescued impairments in hippocampal degeneration and hippocampus-dependent memory by PTD. These observations support our conclusion that PTD treatment impairs CREB signaling pathway, thereby leading to hippocampus-dependent memory impairments.

Keywords: Vitamin B1, memory, hippocampus, inflammation, CREB

SY(T1)2-1

Genotype-based nutrition and dietary guidance

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1. University of North Carolina, Nutrition Research Institute (USA)

Numerous common genetic variants and other complex biological factors influence what we should eat and what we actually end up eating. As the evidence for adjustments based on genomic and -omic information for setting individual intake targets becomes clearer, the development of individualized meal plans remains challenging. We have developed effective strategies that generate detailed food combinations that meet very complex intake targets with high fidelity. The intake targets for individual users are set taking into account estimated energy requirements, body size, sex, age, genotypes and other sufficiently evidence-supported characteristics. By focusing on intake targets, an unlimited number of algorithms can adjust for multiple factors acting simultaneously on the same intake target. The next step is then to use parabolic functions weighted separately by intake target to calculate the sum of normalized deviations from the optimum for all nutrients in a potential menu. The settings ensure the selection of menus that closely meet all intake targets without allowing any major deviation of individual targets. As more evidence becomes available, these target-setting algorithms can be readily adapted. Currently implemented applications use a wide range of genetic algorithms for which there is sufficient evidence support. In addition to macronutrients und micronutrients, the algorithmic meal plan generation can also take into account individual food sensitivities, intolerances and preferences. Important examples are gluten-free options, vegan choices and low-carbohydrate combinations. The addition of carbon dioxide targets can help consumers to make climate-conscientious food choices that align with their nutritional and health needs.

Keywords: Precision nutrition, dietary guidance, mealplan tailoring, multifactorial meal optimization, artificial intelligence

Conflict of Interest Disclosure: None

SY(T1)2-2

Genomic and nutrigenomic contributions to plasma triglycerides

Jose L. Santos[1]

1. Pontificia Universidad Católica de Chile (Chile)

I will review first the epidemiology of severe hypertriglyceridemia (>885 mg/dL; around 1/600), distinguishing the prevalence and genetic architecture of Familial Chylomicronemia Syndrome (FCS; monogenic) versus the Multifactorial Chylomicronemia Syndrome (MCS; complex-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

multifactorial). In FCS, rare mutations in classical genes involved in triglyceride-rich lipoproteins have been clearly delineated around the function of the lipoprotein lipase (LPL): LPL itself, APOA5, APOC2, LMF1, and GPIHBP1. Moreover, severe hypertriglyceridemia is also found in congenital generalized lipodystrophies (for example, due to AGPAT2 mutations) characterized by extreme leanness, low or absent circulating leptin, insulin resistance and impaired eating behaviour. Additionally, it has been described that persons with loss-of-function mutations in APOC3 gene display a cardioprotective profile of low plasma triglycerides (both basal and after a fat meal test), representing a paradigmatic nutrigenetic interaction. This observation and subsequent research has led to the generation of new therapies against severe hypertriglyceridemia based on inhibiting Apo-CIII action. On the other hand, multiple gene variants have been significantly associated with plasma triglycerides through Genome Wide Association Studies (GWAS) at a population level. In contrast to GWAS carried out in other complex biomedical traits, many significant signals for plasma triglycerides are closely related to genes belonging to biochemical pathways involved in triglyceride-rich lipoprotein metabolism. In these studies, polygenic risk scores also contributes to the identification of the genomic load related to multifactorial hypertriglyceridemia. The genetic architecture of plasma triglycerides (from monogenic to multifactorial) represents a suitable trait to study nutrient-gene interactions.

Keywords: Triglycerides, nutrigenetic, dyslipidemia

SY(T1)2-3

Integrated omics for applying in food and nutrition sciences

Hisanori Kato[1]

1. The University of Tokyo (Japan)

The significance of combining different omics in nutrition will be discussed in today's talk.

Habitual coffee consumption reduces the risk of obesity and diabetes. To explore the mechanism, mice were fed a high-fat diet and the effect of adding coffee powder was examined. Coffee powder suppressed weight gain and fat accumulation. The results of transcriptomics, proteomics, and metabolomics showed that coffee consumption suppressed the transcription factor PPARg and its downstream factors, and activated the TCA cycle and the urea cycle. The latter suggested that ATP consumption was promoted by coffee. On the other hand, we searched for loci that correlated with the frequency of coffee consumption in the Japanese population. Genome-wide association analysis revealed a locus strongly associated with coffee intake frequency at position 12q24.

In general, proteins that are digested and absorbed well are regarded nutritionally superior. On the other hand, proteins that are not digested and absorbed well (resistant proteins) are known to have positive effects on the intestinal tract and others. We found that eggshell membrane (ESM), a resistant protein, had an ameliorative effect in both the DSS-induced and IL-10 knockout mouse models of inflammatory colitis. Metagenomics revealed that it ameliorates dysbiosis associated with colitis. Transcriptomics results showed that ESMs are effective in reducing colonic inflammation and maintaining intestinal integrity. Transcriptomics, proteomics, and metabolomics showed metabolic ameliorating effects of ESM.

These results indicate that the integration of omics can provide very useful and broad information in food and nutrition research.

Keywords: omics, functional food, GWAS, resistant protein, coffee

SY(T1)2-4

Epigenetics and Mediterranean diet

Omar Ramos-Lopez[2], *J. Alfredo Martinez*[1]

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The Mediterranean diet (Med-Diet) is one of the most investigated and well-known healthy dietary patterns worldwide, which generally consist of daily intakes of fruit and vegetables, whole grains, legumes, nuts, fish, white meats, and olive oil, although it may also include moderate consumption of fermented dairy products, and red/white wine during the main course. The Med-Diet has been associated with a lower risk of develop cardiovascular disease, obesity, diabetes, cognitive decline, breast and colorectal cancers, depression, erectile dysfunction and asthma. Moreover, it has been shown that this dietary pattern may also reduce markers of inflammation/oxidative stress and metabolic syndrome features. Interestingly, scientific evidence suggests that the beneficial effects of the Med-Diet on health may be putatively mediated in part by epigenetic mechanisms, which may regulate gene expression without concomitant variations in DNA nucleotide sequence, providing a connection among genetics, diseases, and the environment. Actually, DNA methylation is one of the most studied epigenetic processes, which occurs by the addition of a methyl group in the carbon 5' position of a cytosine. Of note, nutrients and specific dietary components of the diet are able to modify gene expression at the transcriptional level through changes in DNA methylation. In this context, an ancillary study within the PREDIMED-Navarra study revealed that adherence to Med-Diet was associated with the methylation status of genes related to inflammation and immunocompetence (*EEF2*, *COL18A1*, *IL4I1*, *LEPR*, *PLAGL1*, *IFRD1*, *MAPKAPK2*, *PPARGC1B*), with a potential regulatory impact. In addition, specific components of Med-Diet, particularly nuts and extra-virgin olive oil (EVOO), were able to induce methylation changes in several genes in peripheral white blood cells, including those related to intermediate metabolism, diabetes, inflammation and signal transduction (i.e., *CPT1B* and *GNAS*). Also, cg01081346 was associated with PUFAs intake, showing a role for specific fatty acids on epigenetic modulation. Furthermore, lower methylation of the *CAMKK2* gene (involved in the regulation of critical metabolic processes such as adiposity and glucose homeostasis) was associated with inadequate folate intake and higher HOMA-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

IR index in subjects with obesity. Summing up, these findings shows that the Med-Diet may induce changes in the epigenome through methylation mechanisms, which occurred in genes mainly related to inflammation, but with other potential roles on adipogenesis, metabolism, angiogenesis and diabetes. The analysis of dietary and nutritional biomarkers and the progress in the epigenetics field is contributing not only to define new nutrient roles in health and disease, but also could facilitate the design and implementation of precision nutrition strategies targeting the epigenome. Besides, this knowledge has led to the search for epigenetic biomarkers to predict the risk of developing chronic diseases and personalizing their prevention and treatment with a precision nutrition target.

Keywords: Med-Diet, epigenetics, DNA methylation, gene expression, precision nutrition

SY(T1)3-1

Retinoic Acid and Its Nuclear Receptors in Health and Disease

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We are interested in understanding linkages between vitamin A metabolism and actions and chronic disease development, specifically metabolic disease and acute lung disease. Our research has used knockout and transgenic mouse models to study vitamin A actions in facilitating and regulating insulin secretion. Early studies explored the role of all-*trans*-retinoic acid [ATRA] in glucose stimulated insulin secretion, using a transgenic mouse that expressed specifically in pancreatic β-cells a dominant-negative retinoic acid receptor-α [RARdn] transgene that ablated most retinoic acid receptor [RAR] and ATRA signaling in these cells. These studies established that ATRA-RAR signaling is required for maintaining normal glucose-stimulated insulin secretion and for maintaining β-cell mass within the endocrine pancreas. Recently, our focus has shifted to ATRA-RAR actions in enteroendocrine cells [EECs] present within the small intestine. We have focused specifically on the incretin-secreting K- and L-cells, which respectively secrete glucose-dependent insulinotropic polypeptide [GIP] and glucagon-like peptide-1 [GLP-1]. GIP and GLP-1 are hormones secreted in response to nutrient arrival in the gut and they signal β-cells to secrete insulin. We studied mice that lack retinol-binding protein 2 [RBP2], which show elevated GIP secretion in response to an oral fat challenge. RBP2 plays a role in channeling substrate retinol towards ATRA formation. These investigations identified a role for ATRA-RAR in facilitating GIP release from K-cells. Our findings establish further that ATRA-RAR signaling is needed to assure normal differentiation of K-cells within intestinal crypts and along the crypt-villus axis. We are presently continuing our investigations of retinoid actions in EEC biology aiming to identify the processes through which ATRA-RAR signaling affects GIP release into blood in response to nutrient signals.

Recently, we initiated investigations in mice into the importance of ATRA-RAR signaling in the response of the lung to experimentally-induced acute respiratory distress [ARD]. We have focused on identifying ATRA-RAR actions in cells residing in the alveolar niche; lung lipofibroblasts [LFs], in alveolar epithelial type 2 cells [AEC2s] and in vascular endothelial cells [ECs] The current understanding of vitamin A biology in these cells is that hepatic vitamin A stores are mobilized as retinol bound to retinol-binding protein 4 (RBP4) and delivered through the circulation to lung cells where they are taken up and used for ATRA synthesis and ATRA-RAR-mediated transcriptional regulation. Our data indicate that this is incorrect and that local vitamin A stores present within each of these 3 distinct cell types of the alveolar niche are critically needed for maintaining the health of the alveoli. Single-cell RNA sequencing data establish that retinoid stores are found in LFs, in AEC2s and in ECs, and that each of these lung cell types expresses key genes needed for retinoid uptake, accumulation, and intercellular transfer. These cellular stores buffer the lung against the adverse consequences of ARD. Mice that genetically lack the ability to store vitamin A locally are more vulnerable to developing more severe ARD and death due to the loss of alveolar barrier integrity and impaired surfactant production, clearance of inflammatory stimuli, and alveolar regeneration.

Keywords: Retinoid, Incretin, Lung Disease, Adipose Tissue, Retinol

Conflict of Interest Disclosure: None

Further Collaborators: No further collaborators have any conflicts to disclose.

SY(T1)3-2

Vitamin K, GGCX, and SXR

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Vitamin K is a fat-soluble vitamin which was originally discovered as an essential factor for blood coagulation. It functions for protein modulation as a co-factor for g-glutamyl carboxylase (GGCX), of which substrates include blood coagulation factors, bone matrix proteins and several other proteins. Alternatively, we previously demonstrated that vitamin K could regulate transcription by activating steroid and xenobiotic receptor (SXR). Interestingly, several studies revealed vitamin K is associated with some aging-related diseases including osteoporosis, osteoarthritis, sarcopenia, dementia, depression and frailty. Here we will discuss the roles of vitamin K, GGCX and SXR in human and animal models with genetic, biological and epidemiological studies.

References:

1) Azuma K, Inoue S: Vitamin K Benefits in Aging and Cancer. (2015) ***Aging Mechanisms, Longevity, Metabolism, and Brain Aging***, Chapter 13 (edited Mori N, Mook-Jung IH) Springer Science+Business Media, New York, (pp.223-239)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

2) Azuma K, Inoue S: Multiple Modes of Vitamin K Actions in Aging-Related Musculoskeletal Disorders. ***Int J Mol Sci***. 2019 20:2844.

3) Shiba S, et al.: Vitamin K-dependent gamma-glutamyl carboxylase in Sertoli cells is essential for male fertility in mice. ***Mol Cell Biol***. 2021 41(4): e00404-20.

Keywords: Vitamin K, GGCX, SXR, PXR, Age-related disease

Conflict of Interest Disclosure: None

SY(T1)3-3

Elucidation of molecular mechanism of vitamin D actions using genetically modified rats

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The active form of vitamin D_3, 1α,25-dihydroxyvitamin D_3 (1,25D3), exerts various physiological actions involved in calcemic, osteogenic, anti-cancer, and immune responses. Recent studies have suggested other effects of vitamin D and/or the vitamin D receptor (VDR), including VDR-independent effects of 1,25D3, VDR-dependent or -independent effects of 25-hydroxyvitamin D_3 (25D3), and ligand-independent effects of the VDR. We have generated a novel *in vivo* system including genetically deficient or modified rats in the *Cyp27b1* or *Vdr* gene using genome editing method [1]. Human type II rickets model rats with a mutant *Vdr* (R270L), which recognizes 1,25D3 with an affinity equivalent to that of $25(OH)D_3$, were also generated. *Cyp27b1*-knockout (KO), *Vdr*-KO, *Vdr* (R270L) rats showed symptoms of rickets including growth retardation and abnormal bone formation. Among these model animals, *Cyp27b1*-KO rats had notably low levels of calcium in the blood and the most severe growth retardation, while *Vdr*-KO rats showed abnormal skin formation and alopecia [1]. Recently, we have generated another human type II rickets model rats with a mutant *Vdr* (H301Q), which shows much lower affinity for both 25D3 and 1,25D3 than the wild-type *Vdr*. In addition, we generated a double variant *Vdr* (R270L/H301Q) which has almost no ability to bind 25D3 and 1,25D3. The differences between wild type (WT) and *Vdr* (R270L) rats could be a result of VDR-dependent effects of 1,25D3. The differences between *Vdr* (R270L) and *Cyp27b1*-KO rats could be derived from VDR-independent effects of $1,25(OH)_2D_3$. Comparison of the *Vdr* (R270L/H301Q) and *Vdr*-KO rats could reveal ligand-independent effects of VDR. Based on the result that *Vdr* (R270L/H301Q) rats did not show alopecia, ligand-independent effects of VDR appear to play essential roles in hair cycle. These results strongly suggest that our novel *in vivo* system is useful for elucidating the molecular mechanism of vitamin D actions. [1] Nishikawa *et al.*, **Sci Rep 10**, 5677 (2020)

Keywords: Vitamin D, vitamin D receptor, rickets, alopecia, genome editing

SY(T1)3-4

Targeting the nuclear receptor PPARalpha to treat metabolic disease

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The peroxisome proliferator-activated receptor a (PPARa) is a ligand-dependent transcription factor that belongs to the nuclear receptor superfamily. PPARa is activated by various kinds of lipid species including fatty acids and phosphatidylcholine (C16:0-18:1), as well as by a class of chemicals known as peroxisome proliferators. In a clinical setting, PPARa is also the molecular target of the fibrate derivatives for hyperlipidemia patients. Studies in rodents and humans have shown that PPARa as a master transcription factor governs hepatic lipid metabolism during starvation, and exerts anti-inflammatory functions as well. Here I will present our recent work identifying a novel PPARa target gene encoding a secretory peptide hormone from the liver, which controls systemic energy balance. Our work is revealing a new endocrine signaling axis from the liver to the brain, with implications for therapeutics.

Keywords: Nuclear receptor, PPARalpha, Liver, Endocrine hormone, Systemic energy balance

SY(T1)4-1

Diet timing and chronic disease – epidemiological evidence of chrono-nutrition

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It is becoming increasingly evident that it does not only matter ***what*** we eat, but also ***when***. The research on biorhythms, nutrition and health is called chrono-nutrition. This is particularly relevant as our daily patterns are becoming less regular in our 24h economy, e.g. with more people working in shifts. The timing of eating, or temporal eating patterns, are a possible modifiable risk factor for cardio-metabolic diseases, including type 2 diabetes. Many metabolic processes in our body follow a circadian pattern. Disruption of these circadian patterns or misalignment between the timing of eating and endogenous circadian systems could have adverse health effects, including impaired cardio-metabolic health. Chrono-nutrition involves studying the impact of nutrition on circadian patterns including different aspects of time: frequency, regularity and clock time. This talk will present data on recent findings and insights on epidemiological evidence of meal timing on cardio-metabolic health.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Chrono-nutrition, temporal eating patterns, dietary patterns, non-communicable diseases (NCDs)

Conflict of Interest Disclosure: None

SY(T1)4-2

The human circadian system: links to meal timing and type 2 diabetes

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The relationship between circadian biology and metabolism has been elegantly described in animal and cellular models. However, the translational benefit of this work relies on the findings of human studies. This research involves highly controlled laboratory protocols in addition to interventions within free-living people.

The presentation will describe how many aspects of human metabolism change over the day in healthy volunteers, together with the effect of obesity and type 2 diabetes on these rhythms. The role of the endogenous circadian system in daily metabolic rhythms will then be identified. Finally, the presentation will explore the 2-way interaction between the human circadian system and meal timing. Both published and currently unpublished data will be included.

Keywords: Circadian, chrononutrition, TRF, TRE, diabetes

Conflict of Interest Disclosure: J.D.J. has collaborated with Nestlé and has previously undertaken consultancy work for Kellogg's

Further Collaborators: There are lots of collaborators. I will acknowledge them in the presentation.

SY(T1)4-3

Time-Restricted Eating for the Prevention and Treatment of Cardiometabolic Disease

Emily N.C. Manoogian[1]

1. Salk Institute for Biological Studies (USA)

Circadian rhythms optimize nutrient homeostasis by orchestrating daily rhythms in catabolic and anabolic metabolism to the appropriate time of the 24 h day. Chronic circadian rhythm disruption predisposes individuals to cardiometabolic diseases including Type-2 diabetes, obesity, and hyperlipidemia. Conversely, maintaining a daily rhythm of feeding and fasting sustains a robust circadian rhythm in metabolism. In animal models, time-restricted feeding (TRF) has been used as a successful intervention for the prevention and treatment of cardiometabolic diseases even on a high-fat and/or high-sugar diet. Benefits of TRF were also seen in mice with a genetically disrupted circadian clock. Clinical trials in humans have also shown widespread health benefits of time-restricted eating (TRE) including improved glucose regulation, decreased blood pressure, and decreased atherogenic lipids. This talk will discuss the current understanding of how TRE impacts cardiometabolic health and where the field is going.

Keywords: Time-Restricted Eating, Circadian, fasting, cardiometabolic

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)4-4

Food-log app-based chrono-nutritional survey and intervention reveal effective information on weight loss and sleep

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Prevention of obesity and type 2 diabetes is an essential research issue worldwide. Chrono-nutrition-based optimal weight-loss strategies have not been well-studied. This study explored the weight-loss parameters from six months of dietary data from 10,000 individuals (20–69-year-old men and women) recorded in a diet-tracking app. The results showed that carbohydrate intake contribution was significant along with age, sex, and app use duration. Particularly, carbohydrate intake correlated with weight loss in the order, dinner, lunch, and breakfast. Therefore, we conducted four 1-month interventions based on the chrono-nutritional evidence for the app users; 12-h time-restricted eating (TRE), increasing breakfast and decreasing dinner, decreasing carbohydrate content at dinner, and frequently logging the food intake and body weight. The participants of the intervention group showed improved sleep patterns, well-being, and daytime physical fitness than those in the control group. In addition, the subjective achievement for each intervention was correlated with weight loss. Cluster and multiple regression analyses revealed that decreasing carbohydrate content at dinner positively correlated with weight change. Thus, the most effective weight loss strategy is to reduce the carbohydrate content at dinner. In addition to the above topic, we would like to share our chrono-nutritional research, including investigation of the functional nutrients and the personalized chrono-nutrition.

Keywords: Chrono-nutrition, circadian clock, phone App, losing weight

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)5-1

Adaptive changes in nutrient-induced GLP-1 secretion in diet-induced obese model rats

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Glucagon-like peptide-1 (GLP-1) is a gut hormone produced in enteroendocrine L-cells. Secretion of GLP-1 is acutely stimulated by luminal nutrients, which results in enhanced insulin secretion from the pancreatic beta-cells and various postprandial responses. GLP-1 is produced mainly (not limitedly) in the distal small intestine and the large intestine. For postprandial GLP-1 response, small intestinal GLP-1-producing cells rather than colonic ones are more likely responsible. Some of molecular mechanisms underlying respective nutrient-induced GLP-1 secretion have been elucidated. Although GLP-1 receptor agonists are recently used in the treatment of type 2 diabetes, changes in GLP-1 production/secretion under obese/diabetic conditions are not well characterized both in human and animal research [1,2]. We investigated whether nutrient-induced GLP-1 secretion is increased or diminished in diet-induced obese model rats. Rats were fed a high-fat and high-sucrose (HFS) diet for 8 weeks or 6 months, which resulted in higher body weight gain, and postprandial glycemia than rats fed a normal diet. During the experimental period, meal tolerance tests (MTTs) were performed every 2-4 weeks, and glycemic, insulin, and GLP-1 responses were monitored. In the MTTs, rats were orally given a standard diet or a liquid meal to compare postprandial responses to identical meals. Compared to rats fed a normal diet, rats fed the HFS diet had higher glycemic, insulin and GLP-1 responses in MTTs [3]. However, intestinal GLP-1 concentration and proglucagon mRNA expression levels did not differ between treatments. In rats treated with continuous administration of a GLP-1 receptor antagonist, the HFS diet further increased postprandial glycemia compared to rats fed the HFS diet without GLP-1 receptor antagonist treatment [4]. In genetically diabetic Goto-Kakizaki rats, feeding the HFS diet for 6 months did not enhance postprandial GLP-1 secretion compared to the GK rats fed a normal diet, while glycemic responses were higher than normal rats fed the HFS diet [5]. These results suggest that enhancement of the postprandial GLP-1 response during obesity development has a role in maintaining a normal postprandial glycemic response. Because GLP-1 productions were not increased in the small intestine, we speculate that the nutrient-sensing functions of GLP-1-producing cells are modified by continuous feeding of an obesogenic diet.

Further investigations are needed to clarify the adaptive changes in GLP-1-producing enteroendocrine cells under dietary, obese, and diabetic conditions.

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[2] Hira T, et al. What Is GLP-1 Really Doing in Obesity? Trends Endocrinol Metab. 2020 Feb;31(2):71-80.

[3] Nakajima S, et al. Postprandial glucagon-like peptide-1 secretion is increased during the progression of glucose intolerance and obesity in high-fat/high-sucrose diet-fed rats. Br J Nutr. 2015 May 14;113(9):1477-88.

[4] Pinyo J, et al. Enhanced postprandial glucagon-like peptide-1 secretion during obesity development has a protective role against glucose intolerance induction in rats. Br J Nutr. 2019 Aug 28;122(4):411-422.

[5] Pinyo J, et al. Diet-induced obesity enhances postprandial glucagon-like peptide-1 secretion in Wistar rats, but not in diabetic Goto-Kakizaki rats. Br J Nutr. 2021 Aug 28;126(4):518-530.

Keywords: GLP-1, Diet-induced obesity

SY(T1)5-2

The enteroendocrine system in human health and in gastrointestinal disease

John McLaughlin[1]

1. University of Manchester (UK)

The gastrointestinal (GI) tract contains a diffuse set of gut hormones secreting cells, the enteroendocrine system. Despite enteroendocrine cells comprising only ~1% of epithelial cells, collectively they form the largest endocrine system in the human body. There are at least 12 subtypes described, secreting multiple hormones which are mainly peptides. Partly because of its inaccessibility and diffuse nature the full roles and integrated functions of the enteroendocrine system are very incompletely understood. It is well established that they play key roles in the digestion and absorption of ingested food through their effect on intestinal secretions (eg gall bladder contraction via cholecystokinin (CCK) and pancreatic secretion via CCK and secretin), and effects on gut motility eg delayed transit via polypeptide YY and glucagon-like peptide-1).

A more recent focus has been on their potential role as satiety hormones. However, it is debatable how much of a real-world role they play in normal food intake regulation, and the impact of normal postprandial endogenous gut peptides on appetite-related behaviours in humans in is uncertain. It seems likely that hedonic drives to eat, reward mechanisms and neurocognitive factors may have more of an impact and over-ride these signals. In GI disease however (and following bariatric surgery), there is growing evidence that supraphysiological levels of gut hormones have a major impact on appetite regulation and may drive other symptoms. Perhaps this is an appropriate part of an intrinsic response to injury and inflammation.

Further research is now necessary to better understand the mechanisms involved in appetite regulation and dysregulation and to recognize the potential offered by targeting the enteroendocrine system, both in GI disease and in obesity. This talk will review our current understanding, presenting experimental evidence from both human and model studies.

Keywords: Enteroendocrine, Gut hormones, Appetite, Inflammation, Food intake

SY(T1)5-3

Cellular and molecular mechanisms in the enteroendocrine system

Frank Reimann[1]

1. University of Cambridge (UK)

The gut harbours enteroendocrine cells scattered throughout its epithelium that secrete a plethora of predominantly peptide hormones. These modulate local intestinal physiology, such as peristalsis and nutrient absorption, as well as acting further afield, for instance affecting pancreatic insulin secretion and hunger. Our research is focussed on understanding the basic physiology of the enteroendocrine system and its involvement in the control of metabolism and food intake. Altered gut peptide secretion is thought to underlie the beneficial outcomes of bariatric bypass surgery, including strongly elevated postprandial glucagon-like peptide-1 (GLP-1) and peptideYY (PYY) plasma concentrations. Our laboratory has pioneered the use of fluorescent markers expressed under the control of specific prohormone promoters to label enteroendocrine cells, thus making them available for single cell investigations. Single cell RNAseq identifies different clusters of enteroendocrine cells broadly in line with different hormone signatures in cells derived from both transgenic mice (NeuroD1-Cre labelling) and human intestinal epithelial organoids (ChGA-Venus labelling). Many of these clusters express transporters and receptors enabling responses to specific macro-nutrients. For example, GLP-1 expressing cells use sodium-coupled transporter dependent depolarization to respond to glucose produced from carbohydrate and the G-protein coupled receptor GPR119 to respond to mono-acyl-glycerides produced from fat digestion. We use live cell imaging and whole cell electrophysiology to investigate downstream stimulus secretion coupling in enteroendocrine cells. Once released, many gut hormones engage with specific G-protein coupled receptors, and transgenic mice with Cre-recombinase expression under the control of promotors for these receptors have helped to identify target cells within the gut and the central nervous system. We aim that our research will identify new drugs for type 2 diabetes and obesity that act by targeting gut endocrine secreting cells or their target tissues, thus mimicking the gut endocrine consequences of bariatric surgery.

Keywords: Enteroendocorine cells, secretion, glucagon-like peptide-1, bariatric surgery, diabetes

Conflict of Interest Disclosure: The Reimann/Gribble laboratory currently has research collaborations with Eli Lilly, Astra Zeneca and LGC

SY(T1)6-1

High-Value Nutrition - Growing New Zealand's Science to Take High-Value Foods to the World

Richard Mithen[1]*, Joanne Todd*[1]

1. University of Auckland (New Zealand)

High-Value Nutrition (HVN) is a New Zealand National Science Challenge that supports high quality translational science to enhance NZ's competitive advantage and drive innovation and value generation in New Zealand's food and beverage sector, and to provide insights to the role of foods and diets in promoting and maintaining health. HVN is positioned at the public/private research interface, involving universities, institutes and companies across NZ. Four long-term research themes have been defined: (i) infant health with a spotlight on gut microbiome around weaning; (ii) metabolic health, with a focus on early diabetes: (iii) gastro-intestinal health addressing functional gut disorders; and (iv) immune health with a focus on how diet can contribute to a robust immune system. Within these programs, research includes cohort studies linking dietary patterns with health, and short and long term human dietary intervention studies. The four individual programs are closely associated with each other, and share a common underpinning systems biology approach. Complementary to these themes, HVN leverages genuine and iconic NZ foods into higher value propositions by scientifically evaluating their health benefits. HVN is fully committed to Vision Mātauranga, the New Zealand national policy to unlock the science and innovation potential of Māori knowledge, resources and people.

Keywords: Nutrition, New Zealand, Metabolic Health, Immune Health, Gut Health

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)6-2

A New Zealand Diet for Metabolic Health and Family Wellbeing: Participant Insights

Denise Conroy[1]*, Jenny Young*[2]

1. Plant and Food Research Ltd. (New Zealand), 2. Plant and Food Research Ltd (New Zealand)

This is an ambitious long-term multi-centre dietary intervention study that explores whether consumption of NZ F&B products based on diet principles that include a preponderance of plant-based foods (vegetables, legumes, fruits, unrefined cereals, nuts), together with lean protein from seafood, with smaller portions of lean red meat and dairy, offers

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

health benefits to people at risk of cardiometabolic disease and their families. Such plant-based diets have been shown to improve metabolic, cardiovascular, and wellbeing profiles in people at risk of cardiometabolic disease, however, this concept has not been studied in the NZ population using NZ foods and beverages. A comprehensive participant insights study was fully integrated in to the clinical trial with the aim of better understanding the cognitions, emotions, barriers and motivators for the index person participating in this trial. 40 index persons were interviewed on 3 separate occasions; at week 6, week 12, and week 24 to better understand their lived experience throughout the intervention. The interviews lasted approximately 40-60 minutes each and were undertaken via Zoom to allow for Covid 19 contingencies. 10 of the participants for the consumer insights study are Māori (indigenous persons) and were interviewed by Māori social scientists. A survey will be distributed to all 200 index participants during weeks 52-64 to gain insight into intervention experience and ongoing maintenance behaviour. There will be focus groups at week 40+ (n = 80) to explore participant experiences and their relationship to the diet followed by a survey to all participants (week 48+) to better understand their overall experiences of participation, ongoing maintenance, and with the food supplied. To date findings suggest that participants are reporting participation in this study has allowed them to 're-set' their relationship with food, to better understand portion size, to re-think when and where they are eating and to seek support when they feel it is needed. The entire family participating in this intervention has been welcomed, not just because the index person does not feel isolated but also because they feel the family's health focus has shifted.

Keywords: Family, diet intervention, consumer insights, qualitative, New Zealand

Conflict of Interest Disclosure: None

Further Collaborators: Clinical work PI Professor Jeremy Krebs

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SY(T1)6-3

Peak Nutrition for Metabolic Health - driving a reduction in pre-diabetes in the Asian consumer

Jennifer Miles-Chan[1,2,3], Ivana Sequeira[1,2], Louise Weiwei Lu[1,2], Mike Taylor[1,2], Karl Fraser[2,3,4], Sally Poppitt[1,2,3], on behalf of the PANaMAH team

1. University of Auckland (New Zealand), 2. High Value Nutrition National Science Challenge (New Zealand), 3. Riddet Centre of Research Excellence (CoRE) for Food and Nutrition (New Zealand), 4. AgResearch Limited (New Zealand)

The maintenance of metabolic health is a global challenge. In China alone almost 1 in 3 individuals are struggling with their body weight, and across Asia a staggering 300 million people have been diagnosed with type 2 diabetes, many in new urban mega cities. Previously common in the *'over-weight and over-forties'*, for many Asian consumers risk increases even whilst young and outwardly quite slim. The cause may lie in deposition of body fat within 'unsafe' ectopic stores, such as the pancreas and liver, which has been termed the TOFI profile: *'Thin on the Outside yet Fat on the Inside'*. Furthermore, during recent phenotyping of an Asian and Caucasian cohort in the TOFI_Asia study using blood biomarkers and body/organ fat storage we have shown the biomarker 'fingerprint' to differ significantly between Chinese and Caucasian individuals. However, whether this is due to different physiology, different pathology, or a different background diet remains to be determined.

The High Value Nutrition PANaMAH (Peak Nutrition for Metabolic Health) team is conducting a series of clinical intervention studies in overweight prediabetic cohorts to determine the underlying cause of this ethnic separation of the plasma metabolome. In addition, we also seek to determine the responsiveness of these biomarkers to nutritional intervention utilizing high value New Zealand food and beverages, including focus on personalized postprandial glucose response (PPGR) investigated using machine learning techniques to integrate clinical, metabolome and microbiome markers. These studies range from acute postprandial studies to a 14-day full diet controlled residential trial SYNERGY and an 8-month community weight loss study FERDINAND, using a systems nutrition approach – thus providing multi-level scientific evidence.

Knowledge gained through the PANaMAH research programme will help to better identify individuals at high risk of poor metabolic health, and also to optimize dietary strategies to prevent the development and/or progression of metabolic disease. In doing so, we will also provide the New Zealand food and beverage industry with valuable information with which to develop and market high value products targeting the metabolic health space.

Keywords: Metabolic Health, Prediabetes, Diet, Ethnicity, Systems Nutrition

Conflict of Interest Disclosure: None

SY(T1)6-4

Unlocking the puzzle of functional gut disorders, assessing novel biomarkers targeting gut comfort

Nicole Clemence Roy[1,4,5], Richard Gearry[1,4], Jasjot Maggo[1,4], Hwei Min Ng[1,4], Simone Bayer[1,4], Karl Fraser[2,4,5], Janine Cooney[3,4], Diana Cabrera[2,4], Wayne Young[2,4,5]

1. University of Otago (New Zealand), 2. AgResearch (New Zealand), 3. Plant and Food Research (New Zealand), 4. High-Value Nutrition National Science Challenge (New Zealand), 5. Riddet Institute Centre of Research Excellence (New Zealand)

Background: Gut health is central to wellbeing, and deviation from the physiological norm is becoming increasingly common among consumers. Functional gut disorders (FGDs) cause pain discomfort and debilitate a person's quality of life. However, despite a high prevalence rate worldwide, the cause of FGDs remains relatively unknown. Alterations in the microbiome, host-

microbial metabolism, immune function, sensitivity, and motility in the gut occur in FGDs. Between 60-89% of individuals with an FGD believe that diet exacerbates symptoms. Therefore, most individuals seek to modify their dietary intake or consume foods to help alleviate symptoms. For example, several studies have shown that consuming green kiwifruit or gold kiwifruit improved gut health by regulating laxation in people with constipation. However, the mechanisms by which kiwifruit improves gut relief and digestion remain ill-defined.

Methods: Two studies were carried out to generate mechanistic insights by which kiwifruit improves gut relief and digestion in participants with constipation. In both studies, patient-reported outcomes of gut symptoms and biological markers were assessed on all participants at baseline and four weeks of intervention. The first study aimed to identify potential mechanisms impacted by consuming gold kiwifruit in a single-blinded, positive controlled, randomised, cross-over study in home settings. Two gold kiwifruit or psyllium (fibre-content matched) was consumed daily for four weeks by participants with or without constipation. The microbiome composition and functional potential were analysed by shotgun metagenomic sequencing of faecal DNA. In addition, metabolomics analysis of plasma and faecal samples was performed using mass spectrometry to monitor polar and non-polar plasma metabolites. The second study aimed to generate comprehensive data on the changes in the gut physiology and associated host-microbiome interactions to the habitual sustained consumption of two green kiwifruit per day or maltodextrin for four weeks in participants with constipation. In addition to the metagenome and metabolome analyses, transit and gas profiles along the gut and colonic volume were measured.

Results: In the first study, the interventions had different effects on plasma and faecal metabolites in all participants, regardless of their health status. Neurotransmitter pathway mapping revealed that the relative plasma concentrations of tryptophan and tyrosine, neurotransmitter precursors, in constipated participants consuming kiwifruit were lower than downstream metabolites in their respective pathways. In contrast, the constipated participants consuming psyllium accumulated tryptophan and tyrosine in plasma, while the concentrations of downstream metabolites were lower in their respective pathways. This finding highlights potential mood benefits over and above those related to increased laxation in constipated participants consuming kiwifruit. In addition, the interventions had differential effects on the taxonomic composition (*Eggerthella* and *Bacteroides genera*) and predictive function (carbohydrate metabolism, metabolism of cofactors and vitamins, and transporters) of the faecal microbiome in all participants, regardless of their health status. **Conclusion:** The findings from these studies will provide insights into molecules of the host-microbial interactions and physiological changes associated with the positive impacts of consuming kiwifruit for gut relief and digestion.

Keywords: Nutrition, Kiwifruit, Functional gut disorders, Gut function, Microbiome

Conflict of Interest Disclosure: None

Further Collaborators: The collaborators of the Digestive Health priority research programme.

SY(T1)6-5

Exploring the immunometabolic response to nutrition

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Although nutrition impacts immune function, the underlying mechanisms of action remain poorly defined. Over the past decade, the functional range of immune cells, including T cells and dendritic cells, has been consistently linked to distinct shifts in cellular metabolism, thus firmly anchoring the novel paradigm and field of research of 'immunometabolism'. As diet likely influences immunometabolism, but remains virtually unstudied in that context, the Immune Health Programme of the high-value nutrition (HVN) national science challenge is dedicating significant resources to determine the inter-relationship between diet and immunometabolism and how dietary interventions may be used to reprogram cellular metabolism of peripheral immune cells. We will introduce the general principles of immunometabolism, describe metabolic flow cytometry, a newly developed methodology which enables the exploration of immunometabolism at the single cell level in peripheral blood mononuclear cells (PBMC), and highlight key observations made to date with PBMC after ingestion of individual dietary constituents or completion of more complex nutritional interventions.

Keywords: Nutrition, Immunity, Immunometabolism

Conflict of Interest Disclosure: The authors declare no conflict of interest.

SY(T1)6-6

Feeding through seeding: nourishing the infant microbiome that supports immune health

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Background and objectives: The early stages of gut microbiome development are marked by unique temporal microbe uptake, colonization, and selection, all of which have variable functional characteristics throughout time. This carefully managed microbial sequence begins at birth and continues until the microbiome acquires an adult-like makeup and function around 3 years of age. Early life nutrition has been shown to be the most important modulator of the microbiome with

breastmilk seeding and modulating the microbiome with beneficial bacteria. The introduction of solid foods which are largely influenced by physiological development, culture and tradition has a significant impact on the change and development of the gut microbial diversity. Our programme aims to investigate the establishment of immune protection-beneficial microbiomes during and after the introduction of solid food.

Methods: Through data mining we have identified bacteria with supporting evidence for beneficial modulation of the evolving infant GI and systemic immune system and identified lead candidates to feed these beneficial bacteria. A pilot study has enabled us to explore the relationship between dietary intake in infants from the commencement of solids to 12 months of age and its effect on the microbiome. The pilot study also determined the feasibility to conduct a RCT.

Results: The pilot study demonstrated that the infant diet is characterized by high inter and intra individual variation of food groups compared to nutrient composition which remains relatively stable over time. The pilot study also demonstrated it is feasible to conduct a larger RCT.

Conclusion: The RCT Seeding through Feeding: nourishing the infant microbiome to support immune health (SUN) is currently underway. This study will enable us to examine the associations, and possible causality between prebiotic feeding, growth of immune health-beneficial microbes in the infant gut, with reduced number of respiratory infections and improved vaccination responses.

Keywords: Infant, Microbiome, Prebiotic, Immune

Further Collaborators: on behalf of the Infant Health Team.

SY(T1)7-1

Neural mechanisms of post-ingestive learning

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Animals must learn through experience which foods are nutritious and should be consumed, and which are toxic and should be avoided. This learning process is critical for survival in the wild and contributes to the motivational pull of energy dense foods in modern society. However, we have only a rudimentary understanding of the underlying cells, signals and pathways. I will describe our work developing genetic tools to monitor and manipulate GI sensory pathways in the mouse, and the application of these tools to investigate mechanisms of post-ingestive learning.

Keywords: Neural circuit, homeostasis, food intake, gut-brain

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)7-2

The Vagus Nerve and the Physiology of Reward

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The presentation will outline neural circuits via which body organs, such as the gastrointestinal tract, may regulate reward and decision making. The presentation will also discuss circuitries via which the brain predicts future states and achieves control over certain body parts, for example the craniofacial and gastric musculatures. The identification of neurons and circuits for body-brain communication provides new insights into how internal signals generate behavioral actions and reinforcement learning.

Keywords: Dopamine, Gut, Reward, Vagus Nerve

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)7-3

A Neural Basis Behind the Hardships of Dieting

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1. National Institutes of Health (USA)

Maintaining healthy body weight is increasingly difficult in our obesogenic environment. Dieting efforts are often overpowered by the internal drive to consume energy-dense foods. Although the selection of calorically rich substrates over healthier options is identifiable across species, the mechanisms behind this choice remain poorly understood. Using a passive devaluation paradigm, we found that exposure to high-fat diet (HFD) suppresses the intake of nutritionally balanced standard chow diet (SD) irrespective of age, sex, body mass accrual and functional leptin or melanocortin-4 receptor signaling. Longitudinal recordings revealed that this SD devaluation and subsequent shift toward HFD consumption is encoded at the level of hypothalamic agouti-related peptide neurons and mesolimbic dopamine signaling. Prior HFD consumption vastly diminished the capacity of SD to alleviate the negative valence associated with hunger and the rewarding properties of food discovery even after periods of HFD abstinence. These data reveal a neural basis behind the hardships of dieting.

Keywords: Dieting, Neural Circuits, Palatable Food, Longitudinal Neural Recordings

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)7-4

Neuronal mechanism of state-dependent modulation of taste preference

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The gustatory system plays a critical role in sensing appetitive and aversive taste stimuli for evaluating food quality. Although taste preference is known to change depending on various factors such as internal states, a mechanistic insight remains unclear. To answer this question, we examine the neuronal mechanisms regulating hunger-induced taste modification in mice. Starved mice exhibit an increased preference for sweetness and tolerance for aversive taste. Agouti-related peptide (AgRP)-expressing neurons in the arcuate nucleus of the hypothalamus play a pivotal role in triggering appetite. We thus evaluate the role of AgRP neurons on hunger-induced taste modification with optogenetic experiments. We found that the hunger-induced taste modification is recapitulated by selective activation of AgRP neurons projecting to the lateral hypothalamus, but not to other regions. Importantly, both appetitive and aversive tastes are modified by the lateral hypothalamus projecting AgRP neurons. We next characterized the lateral hypothalamic neurons that function as downstream neurons of AgRP neurons. Pathway specific chemogenetic experiments showed that glutamatergic neurons in the lateral hypothalamus play a key role in modulating preferences for both appetitive and aversive tastes by using distinct pathways projecting to the lateral septum or the lateral habenula, respectively. Although hunger is known to make food tastier empirically ("Hunger is the best sauce"), our results show the neural mechanism behind the hunger-induced taste modification. In last parts of my talk, the role of other factors except hunger on taste perception will be also discussed.

Keywords: Taste, Hypothalamus, Hunger, Brain

SY(T1)8-1

Anti-obesity and neuroprotective effects of tocotrienols

Koji Fukui[1]

1. Shibaura Institute of Technology (Japan)

Vitamin E is a natural lipophilic vitamin, and the most famous function is an antioxidant. Daily intake of vitamin E prevents oxidation of our body. Vitamin E is selling as a supplement in the private market everywhere, and we can get it very easy. On the other hand, aging process cannot be prevented and is a degenerative process. Aging processes are divided into two categories, one is a physiological and the other is pathological. One mechanism of the progression of pathological aging is closely related to oxidation. To prevent pathological aging, administration of vitamin E is very effective. In our previous study, treatment with vitamin E in rodent models significantly improved cognitive dysfunction such as the Morris water maze and a radial arm maze. On the other hands, obesity is a severe problem all over the world, and increases the risks of secondary diseases such as diabetes, cardiovascular event, and other severe diseases. Recently, our group found that treatment with tocotrienols significantly inhibited body weight gain in obese mice. We tried several treatment volumes and periods, and every sample showed similar effects. However, the detailed mechanisms of anti-obesity effects of tocotrienols have not yet fully understood. We think one is neuroprotective and second is antioxidant effects. For example, treatment with a hydrogen peroxide induced neuronal cell death in a time- and concentration-dependent manner. Hydrogen peroxide is one kind of reactive oxygen species and very small amount of it produce in our body. However, we found that treatment with a low concentration of hydrogen peroxide induced axonal degeneration. The effect of tocotrienol is stronger than that of tocopherols. Obesity has been shown to consume more oxygen and less during calorie restriction. Treatment with tocotrienols may affect not only neural function but also lipid metabolism and mitochondrial function. In this presentation, we will introduce our research results, focusing on tocotrienols.

Biomedicines, 10, 281, 2022
J Clin Biochem Nutr, 69, 256-264, 2021
IJMS, 21, 4533, 2020

Keywords: Vitamin E, Tocotrienols, Anti-obesity, Neuroprotection, Oxidation

Conflict of Interest Disclosure: None

SY(T1)8-2

Role of vitamin K in health and disease

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Vitamin K is an essential bioactive compound required for the activation of vitamin K-dependent proteins, necessary to fulfil physiological functions in our body. Vitamin K can be present in various isoforms, distinguishable by two main dietary structures namely phylloquinone (K1) and menaquinones (K2). The difference in K1 and K2 is seen in the structure which causes different absorption rates, tissue distribution, and bioavailability. Although differing in structure, both act as cofactor for the enzyme gamma-glutamylcarboxylase encompassing both hepatic and extrahepatic cofactor activity. Only carboxylated, hence activated, vitamin K dependent proteins promote a health profile, like hemostasis, strong bones and elastic arteries. Furthermore, vitamin K2 in the form of MK-7 has been shown as most bioactive vitamin K compound in regulating osteoporosis, atherosclerosis, and inflammatory diseases without risk of negative side effects or overdosing. Here we highlight differences

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

between isoforms vitamin K1 and K2 by means of source, function, and extrahepatic activity both in health and disease.

Keywords: Vitamin K, Vascular calcification, MK7, carboxylase

Conflict of Interest Disclosure: LS received consultancy fees from Immunodiagnostic systems (IDS), not related to the submitted work, and grants from NattoPharma, Boehringer Ingelheim, and Bayer, also not related to the submitted work.

SY(T1)8-3

Niacin metabolism and life-style related diseases

Tsutomu Fukuwatari[1]

1. The University of Shiga Prefecture (Japan)

Niacin, also called vitamin B3, refers to both nicotinamide and nicotinic acid. Niacin in the form of coenzymes NAD and NADP functions in many biological reactions such as energy metabolism, redox reactions, ADP ribosylation and sirtuins activation. Recent researches have elucidated that the decreased NAD levels with aging and nutritional status impair energy metabolism, DNA repair, gene expression and cellular stress responses through inactivation of NAD requiring enzymes including poly (ADP-ribose) polymerases (PARPs) and sirtuins, and thus is involved in obese and metabolic diseases. Several studies have shown that obesity and aging lower tissue NAD levels in mice liver, skeletal muscle and adipose tissue. Low NAD levels impair glucose tolerance and reduce insulin secretion in pancreatic β cells. NAD deficiency reduces β-oxidation and consequently causes the accumulation of triglycerides in the hepatocytes, enhances oxidative stress, impairs insulin sensitivity, triggers inflammation in the liver, and hence contributes to the pathogenesis of nonalcoholic fatty liver disease (NAFLD). Supplementation of NAD precursors improves NAD levels, and has beneficial effects for obesity, insulin sensitivity, dyslipidemia and NAFLD. Especially, nicotinamide mononucleotide (NMN) and nicotinamide riboside have superb ability to increase NAD synthesis without inducing side effects. NAD is synthesized from tryptophan by the tryptophan-NAD pathway, nicotinic acid by the Preiss-Handler pathway, and nicotinamide by the salvage pathway. The NAD levels are also regulated by nicotinamide catabolic enzyme nicotinamide *N*-methyltransferase. Patients with obesity, diabetes and NAFLD show reduced expression of nicotinamide mononucleotide phosphoribosyltransferase (Nampt), rate-limiting enzyme in the salvage pathway, in serum, liver and adipose tissue. Nonalcoholic steatohepatitis (NASH) model rats impair niacin nutritional status by reduction of Nampt expression and enhancement of nicotinamide catabolism. These findings suggest that NAD-related metabolic diseases impair niacin nutritional status, and thus niacin therapy is useful tool to improve both diseases and niacin nutritional status.

Keywords: Diabetes, NAD, NAFLD, SIRT, vitamin

SY(T1)9-1

Overview of recent developments of protein quality methodology

Daniel Tome[1]

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Dietary proteins provide nitrogen and AA which are required to support the synthesis of protein, and of numerous nitrogen-containing and AA-derived compounds in the body. Protein are constituted by 20 AA including 9 indispensable AA (IAA) not quantitatively synthesized in humans and which must be supplied in adequate quantity and proportion by the diet, while the other dispensable AA can be de novo synthesized from different precursors. The quality of dietary protein sources can be assessed by measuring utilization and retention of dietary nitrogen and AA in the body, but this approach is difficult due to the complexity of the physiological and metabolic processes of protein digestion and metabolic utilisation of AA. Alternatively, the quality of dietary protein sources can be assessed by their ability to meet nitrogen and IAA requirements for growth, maintenance, and specific physiological states. The three limiting factors for protein quality, include the total protein content, the IAA content and profile of these proteins, and the metabolic availability of the dietary protein-derived AA. Accordingly, protein quality has been assessed by the widely accepted chemical scoring approach that compares the IAA pattern of a protein with reference age-specific IAA requirement patterns corrected for protein or IAA digestibility. This is performed through the two simple indexes, Protein Digestibility Corrected Amino Acid Score (PD-CAAS) and Digestible Indispensable Amino Acid Score (DIAAS). A critical aspect of the chemical scoring approach is measurement of protein and IAA digestibility to correct the chemical score. The PD-CAAS that corrects the chemical IAA score by a single faecal nitrogen digestibility value has been subject to criticism. Indeed, faecal digestibility is not always a good proxy of AA digestibility, especially for low digestible proteins, possibly due to the contribution of colonic microbes to nitrogen transactions through the fermentation of undigested protein entering the colon. In addition, there are differences in digestibility between different AAs and taking a single protein nitrogen faecal digestibility value for the different AA can lead to other or underestimate the specific digestibility of each individual AA. To overcome these concerns, the DIAAS corrects the chemical score of each individual IAA for the true specific oro-ileal digestibility of the same IAA. The question of AA metabolic availability has been discussed and several models and methods of measuring protein and AA digestibility are currently available including human, pig, rat, and in vitro models. The methods traditionally assess nitrogen and AA disappearance in the intestine by measuring oro-fecal or oro-ileal balance, and more recent methods, including the dual isotope tracer method or Indicator AA oxidation method, directly measure the systemic availability of dietary AA. These methods have been applied to assess ileal digestibility of protein and IAA from different dietary sources. Moreover, the PDCAAS is truncated to 100% and does not indicate the potential of a high-quality protein to optimise the IAA composition of food mixtures with other low-quality protein,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

while DIAAS is not truncated to indicate the potential of a high-quality protein to complement low-quality protein in mixed diets.

Keyword: protein, Amino acid, digestibility, quality, Nutrition
Conflict of Interest Disclosure no

SY(T1)9-2

Porcine model for routine detection of protein digestibility in humans

Hans H Stein[1]

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Background and objectives: Because of the similarities of the digestive tracts in humans and pigs, routine determination of digestibility of amino acids (AA) in human foods may be accomplished using a porcine model. The objective of the present work, therefore, was to demonstrate the suitability of using a porcine model to routine determination of protein quality of human foods.

Methods: A T-shaped cannula was installed in the distal part of the small intestine of pigs (the ileum), which allowed for collection of ileal fluids from pigs fed food proteins or a protein-free diet. Collected samples were lyophilized and analyzed for AA and values for standardized (true) ileal digestibility of AA were calculated. By comparing these values to reference patters for AA requirements for different groups of humans, values for the Digestible Indispensable Amino Acid Score (DIAAS) were calculated in a number of food proteins including cereal grains, pulses, oilseed concentrates and isolates, nuts, protein hydrolysates, pork, beef, fish, and dairy products.

Results: Results demonstrated that pigs easily consume any food protein that humans consume and calculation of DIAAS in food proteins is straight forward using the porcine model. In general, greater DIAAS values were calculated for animal proteins than plant proteins, but in several cases, processing of plant proteins such as fermentation or heat treatment, increased DIAAS. It was also demonstrated that values for DIAAS obtained for individual ingredients are additive in meals consisting of more than one food protein. As an example, DIAAS in the combined meal of a breakfast cereal and milk was accurately calculated from DIAAS values obtained for breakfast cereals and milk alone.

Conclusion: By determining the standardized ileal digestibility in food proteins using the porcine model, values for DIAAS were calculated for individual food proteins. These values can subsequently be used to calculated DIAAS for mixed meals consisting of several food proteins. Use of the porcine model, therefore, is a practical tool to determine the protein value of ingredients and meals consumed by humans and this model offer opportunities to increase the accuracy of food protein evaluation.

Keywords: Amino acids, Digestible Indispensable Amino Acid Score, Food protein, Porcine model, Protein quality

Conflict of Interest Disclosure: None

Further Collaborators: Riddet Institute, New ZealandUniversity of Wageningen, the Netherlands

SY(T1)9-3

New doubly labelled protein method for dietary true ileal amino acid digestibility

Anura Kurpad[1]*, Sarita Devi*[1]

1. St John's Medical College (India)

Protein digestibility is an important and key limiting factor in the availability of indispensable amino acids (IAAs) from foods. It has been refined to specifically measure IAA digestibility, which is used in an index to measure protein quality, called the Digestible Indispensable Amino Acid Score (DIAAS). Protein quality is particularly for vulnerable and poor populations, subsisting on cereal and pulse based diets, and living in challenging environments where intestinal dysfunction may exist. Since the digestion of protein occurs only in the small intestine, and the metabolic activity of colonic bacteria confounds measurements at the faecal level, the measurement of protein digestibility required measurements at the ileal level, using invasive techniques like intestinal intubation and perfusion, or the use of ileostomates, to provide a window into this process. We developed a dual-tracer method with stable isotopes to characterize the IAA digestibility of uniformly labelled ^{2}H-proteins from different food groups like cereals, millets, pulses, algal and animal source foods. These foods were compared with a standard protein with known digestibility, like either ^{13}C-sprulina protein, or a mixture of ^{13}C-labeled crystalline amino acids. In a series of human adult studies, we have measured the digestibility of rice, finger millet, mung bean, chickpea, yellow pea, spirulina, hen's egg and skeletal muscle, and milk protein. We have also measured this in young children, to evaluate optimal cereal-legume mixtures to meet the age-specific DIAAS requirement in complementary foods.

Keywords: Protein Quality, Protein digestibility, Human, Stable Isotope

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)9-4

Digestibility of amino acids in foods of India

Kiran Bains[1]

1. Punjab Agricultural University (India)

Dietary amino acid supply may potentially limit protein metabolism; hence, it is imperative to accurately monitor the dietary supply of 'available amino acids' in relation to the dietary requirements. The availability of lysine is of interest since it is often limiting in cereal-based Indian diets. Furthermore, lysine intakes are marginal in low socio-economic group Indians. The

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DOI: 10.1159/000530786

presence of poorly digested protein fractions and high levels of insoluble fibre and anti-nutritional factors in cereals and legume-based meals are responsible for poor digestibility of proteins. A further consideration is that cereals tend to be limiting in lysine while legumes have less sulphur containing amino acids. Moreover, the losses of available lysine, due to Maillard reactions that may occur during food preparation, exacerbates the problem in cereals and to some extent in legumes. The overall true ileal amino acid digestibility across amino acids for prepared cereal-legume meals ranged from 66 to 93% with a mean overall digestibility of 85%. All the cereal-based foods had lower levels of both gross reactive and true ileal digestible reactive lysine than the lysine requirement for children and adults. When gross total or reactive lysine is used as a determinant of lysine content it would be predicted that only eleven of the twenty-one foods (prepared from cereals and legumes) would be lysine adequate all age groups. Finally, when the lysine content was based on true ileal digestible reactive lysine, only five of the foods would be predicted to be lysine adequate for all age groups, two would be lysine deficient for 1-3-year-old children and fourteen food samples would be lysine deficient for all age groups. This is of concern given that for the majority of the prepared meals and ingredients examined were either marginal or did not meet the nutritional requirements for both children and adults. In the present Indian food scenario, where milk and legume consumption is gradually reduced because of sharp rise in their prices, it is assumed that large Indian population may subsist on lysine inadequate diets which may have detrimental effect on muscle protein synthesis and muscle function.

Keywords: Lysine, Cereal, Legume, Digestibility, India

SY(T1)9-5

Digestibility of amino acids in foods of China

Fei Han[1], Paul Moughan, Juntao Li[2], Natascha Stroebinger[2], Shaojie Pang[1]

1. Academy of National Food and Strategic Reserves Administration (China), 2. Riddet Institute, Massey University (New Zealand), 3. State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University (China).

The aim was to study the protein quality of foods by determining the amino acid content and digestibility of foods in China. The values for the digestible indispensable amino acid score (DIAAS) in cooked cereals and pulses were determined. True ileal digestibility (TID) values of amino acids relevant to adult humans were obtained. It is difficult to determine ileal amino acid digestibility in humans directly, and for this reason, the growing pig or rat is often used to obtain such values, as a preferred animal model. Three animal experiments were conducted. Each cooked cereal, pulse or blends of cooked cereal and pulse was included in a diet as the only source of crude protein. An N-free diet was given to allow determination of gut endogenous AA losses. All animal experiments were carried out in strict accordance with the methods recommended by the Report of the FAO Expert Consultation (2013). The first determined the TID values of AA obtained from nine cooked cereal grains (brown rice, polished rice, buckwheat, oats, proso millet, foxtail millet, tartary buckwheat, adlay and whole wheat) fed to growing rats. Among the TID values obtained, whole wheat had the highest values ($p<0.05$), and polished rice, proso millet and tartary buckwheat had relatively low values. The DIAAS (for children over 3 years old / adolescents / adults) was 68 for buckwheat, 47 for tartary buckwheat, 43 for oats, 42 for brown rice, 37 for polished rice, 20 for whole wheat, 13 for adlay, 10 for foxtail millet and 7 for proso millet. The second determined the TID values of AA obtained from six cooked Chinese pulses (kidney bean, mung bean, adzuki bean, broad beans, peas and chickpeas) fed to growing pigs. It was found that the TID values for the total indispensable AA were higher ($p < 0.001$) for broad beans (87.3%) and lower ($p < 0.001$) for kidney bean (73.3%) than for the other pulses. For the older child (over 3 years), adolescent and adult, the DIAAS (%) was mung bean 94 >; pea 88 >; broad bean 87 >; small bean 78 >; kidney bean 74 >; chickpea 71. The third studied the complementary effect between cereals and pulses on protein quality. The values for the DIAAS in cooked cereals and pulses, given alone (mung bean, adzuki bean, millet and adlay), and blends of cooked cereals and pulses (mung bean + millet and adzuki bean + adlay) were determined. The mean TID values for millet were the highest (89.4%) and the adzuki bean/adlay mixture the lowest (79.5%). For the older child, adolescent, and adult, the DIAAS (%) was 93 for mung beans, 78 for adzuki beans, 22 for millet, 16 for adlay, and 66 for mung beans + millet, 51 for adzuki beans + adlay. The novel data presented on the TID of the amino acids and DIAAS values for cereals and pulses in a form as typically consumed in China enrich the global database of DIAAS values.

Keywords: China cereals, pulses, DIAAS, true ileal protein digestibility, protein quality, growing pig or rat

SY(T1)10-1

Nutrition surveillance in Japan for sustainable population health

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The Japan National Health and Nutrition Survey has been conducted over 70 years. It examines not only dietary intake of the Japanese but also their lifestyles such as physical activity, drinking and smoking. The survey results are utilized to monitor the progress of the national health promotion plan named Health Japan 21. When the lifestyle targets in the second edition of Health Japan 21 are classified according to the levels of the socioecological model, 16 out of 22 targets in lifestyles are at intrapersonal level and 2 targets each are at inter-individual, institution and community levels. The National Health and Nutrition Survey is useful for monitoring most of the target items at intrapersonal level, but no other surveys are regularly utilized to monitor the target items at inter-individual, institutional,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

community and policy levels. Target items at all socioecological levels should be comprehensively incorporated in the national health promotion plan. Also, target items at policy level should be considered as sustainable lifestyles have increasingly become important. A system dynamics model is useful in providing stakeholders and policymakers with a comprehensive understanding of the inter-relationships and feedbacks among lifestyle-related factors at all socioecological levels. Group-model building has become increasingly common in involving stakeholders and policy makers and drawing a causal-loop diagram, one of qualitative models in system dynamics, on dynamic and complex problems. Some examples of group-model building for sustainable food system will be introduced. In 2019, the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) released "Sustainable healthy diets: Guiding principles". It contributes to the Sustainable Development Goals (SDGs) at country level, especially Goals 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-Being), 4 (Quality Education), 5 (Gender Equality), 12 (Responsible Consumption and Production) and 13 (Climate Action). The National Institute of Health and Nutrition, Japan made a commitment entitled "Food-based dietary guideline for SDGs" for the Tokyo Nutrition for Growth Summit 2021. The institute will contribute to sustainable population health by evaluating the nutrition policies of Japan from the viewpoint of SDGs as well as by proposing a food-based dietary guideline for sustainable healthy diets by 2030.

Keywords: National Health and Nutrition Survey, Health Japan 21, Socioecological model, System dynamics, Sustainable healthy diets

Conflict of Interest Disclosure: None

SY(T1)10-2

Contribution of Asian Scientists to Global Nutrition

Jeyakumar Henry[1]

1. ASTAR, Singapore Institute of Food and Biotechnology Innovation (Singapore)

In 1888, Eijkman working in present day Jakarta, reported polyneuritis in chickens fed polished rice. Observing that the disease in chicken, resembled polyneuritis in humans caused by beriberi, Eijkman proposed that beriberi was due to the presence of toxic compounds in polished rice. However, it was his successor Dr Grijns who demonstrated that the lack of thiamine was the primary cause of polyneuritis in beriberi. This illustrates one of the earliest records of nutritional research emerging from Asia, highlighting the significant role Asia has played in the conceptualization and application nutrition science. At about the same time, Japanese scientists both from the army and navy were also pursuing research on the role of polished rice in the etiology of beriberi. This symbolizes the early contribution and role of Japanese scientists in nutrition research. At the turn of the 20th Century (1920), Professor Takahira commenced his pioneering studies on measuring the basal metabolic rate and nitrogen excretion of lean and obese Japanese volunteers and the understanding of the biology of human starvation. His pioneering work laid the foundation of our contemporary understanding of tissue partitioning during starvation. These seminal studies have been rarely referred to, compared with the widely publicized studies on starvation reported by Benedict. An international figure in nutrition science was also Prof C Gopalan who was responsible for initiating nutrition research in India. Post-independence around 1948, India faced numerous nutritional challenges and deficiencies. Gopalan's work on eradicating iron, iodine and other vitamin/mineral deficiencies led to the evolution of public health policies being adopted by numerous other countries in Asia and beyond. Gopalan also pioneered in developing one of the earliest food composition tables in Asia, which even today in its revised form, is extensively used worldwide. Given that Japan has the longest life expectancy at birth, it is instructive to examine and investigate the dietary composition of the Japanese, notably the Okinawa diet. These insights will enable us to redesign and retool diets across Asia to emulate the macronutrients compositions and phytochemical profiles of these diets. This illustrates some of the many contributions that the Japanese and Asian nutritionists continue to play in developing optimal diet for health and longevity. In my presentation I will continue to walk through the history to the present day of how nutrition scientists in Asia had and will continue to make invaluable contributions to global health.

Keywords: Asian nutrition, History of Nutrition, Global Health

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)10-3

Application of nutrition, dietetics and food science in public health interventions in Asia

Sumanto Haldar[1]

1. Singapore Institute of Food and Biotechnology Innovations (SIFBI) (Singapore)

Asia is a global epicenter for type 2 diabetes and cardiometabolic diseases. Due to the wide distribution of GDP across various nations, compounded by increasing economic prudence, there is a double burden of overnutrition, combined with nutritional deficiencies. This problem is anticipated to grow further in the next few decades. Traditionally, across Asia the concept of 'food as medicine' is nothing new. In recent years, a renaissance of food as new medicine emerged through the evolution of 'functional foods', which was first conceptualized in Japan. This has enabled us to make evidence-based claims related to the effects of various foods and food components.

In this talk, I will discuss the role that research in nutrition science, dietetics and food science played in this region through multidisciplinary contributions, which have been pivotal in improving the food systems in Asia and around the globe, to

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DOI: 10.1159/000530786

better public health in the 21st century. Some of the pertinent areas of research will include the use of foods and food components to improve energy regulation and balance, glucose homeostasis, lipid metabolism as well as incorporation of bioactive phytochemicals that are uniquely found in Asian foods and are also culturally appropriate. Furthermore, using state of the art food technology and processing methods to complement nutrition have further enhanced molecular function, structure and sensory profile of foods to improve metabolic health. The talk will also cover the emerging area of chrononutrition, whereby it is not only what we eat but the time when we eat it that matters and how certain dietary components can enhance circadian function and consequently improve health. The final section of the talk will demonstrate some successful examples of the integration of food science, technology, nutrition and dietetics to revolutionize the way we deliver foods with distinctive health benefits, focusing on the unique nutritional challenges facing Asia and highlight how regional cooperation will be the cornerstone to alleviate the risk of type 2 diabetes, obesity and other non-communicable diseases.

Keywords: Nutrition, Dietetics, Food Science and Technology, Cardiometabolic Diseases, Public Health

Conflict of Interest Disclosure: None

Further Collaborators: Not Applicable

SY(T1)11-1

Introduction of oral health: Its global burden

Ken Osaka[1]

1. Tohoku University (Japan)

A Number of studies revealed that poor oral health leads to subsequent systemic health problems including frailty, cardiovascular disease, dementia, stroke, and death. The main mechanism seems to be a change in nutrition intake. It is reported that fewer remaining teeth were associated with less consumption of meat and vegetables. I will present the current situation of the global burden of oral health and its impact on nutrition.

Keywords: Global burden of disease

Further Collaborators: Ass. Prof. Taro Kusama

SY(T1)11-2

Public health fight against sugar

Richard Geddie Watt[1]

1. UCL (UK)

This presentation aims to highlight the importance of reducing free sugars consumption globally through the adoption of radical public health policies. Through a public health lens, the epidemiological evidence on the high intakes of free sugars will be highlighted in the context of World Health Organization 2005 guidelines. Particular attention will however be placed on the rising consumption of free sugars in many low and middle-income countries. The impact of free sugars consumption on general and oral health will then be highlighted. An overview of commercial determinants will be outlined and the direct relevance of this to sugar reduction strategies will be stressed. The presentation will then focus on the limitations of solely adopting clinical and individual level interventions and the importance of implementing a range of complementary upstream public health measures to reduce sugars consumption at a population level.

Keywords: Sugar, public health, commercial determinants

Conflict of Interest Disclosure: None

SY(T1)11-3

Epidemiology of oral health on nutrition and food intake

Jun Aida[1]

1. Tokyo Medical and Dental University (Japan)

Oral health has an essential role in nutritional intake. The chewing function of oral is directly related to eating and nutrition intake. Historically, epidemiological studies have reported the association of oral health with food intake, nutrition intake, and body-mass index. In addition to these direct effects of oral health, recent studies suggest the indirect effect of oral health on nutrition and food intake. Oral health is essential for speaking and smiling. Thus, oral health affects social interactions with others. A recent epidemiology study determined that older people with poor oral health had a higher possibility of eating alone. Eating alone is considered as a social determinant of poor general health. In addition to direct mechanisms such as chewing function, this kind of indirect mechanism is also considered as an important role of oral health on nutrition and food intake. In 2021, the 74th WHO World Health Assembly approved the resolution on oral health, and it described the role of oral health on general health. The role of oral health on food and nutrition intake is considered to be one mechanism between oral and general health. In fact, epidemiological studies using mediation

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DOI: 10.1159/000530786

analysis support this mechanism. This presentation will explain oral health and nutrition intake from a wider range of aspects.

Keywords: Oral health, Epidemiology, Mediation analysis, Social determinants of health, Eating alone

SY(T1)11-4

Clinical effort to improve ingestion and swallowing among disabled older people

Haruka Tohara[1]

1. Tokyo Medical and Dental University (Japan)

There are two characteristic efforts about dysphagia in Japan. One of them is participation of dentist to dysphagia team. Actually, number of the dentists who participate in JSDR is lot. And education about dysphagia is essential for pre graduate dental students. Dentists can make not only dentures, but also particular prosthesis, such as palatal augmentation prosthesis. This can allow us to further approach. Another characteristic effort is home visiting dysphagia rehabilitation. Such intervention has been promoted so far, a lot of medical resources are face with chronic dysphagia patients now. Then, I made dysphagia rehabilitation map (https://www.swallowing.link/) to reveal the medical resources where can correspond with dysphagia. Home visiting rehabilitation should be promoted further to keep general health of prolonged chronic patients. When it comes to our recent studies, we started with developing jaw opening exercise that is training for supra hyoid muscles. Maximum opening of the jaw was effective to strengthen supra hyoid muscles. Then, jaw opening sthenometer was developed also, that allowed us to examine strength of supra hyoid muscles. We found tongue pressure, jaw opening force, and location of hyoid bone are likely to lower in men. Furthermore, trunk muscles and neck muscles related jaw opening force significantly. So, especially men need to keep trunk and neck muscles to prevent dysphagia. We conducted the study to figure out the effect of recovery of oral intake from tube feeding on oral and intestinal bacterial flora. The result was positive. Diversity and dysbiosis was increased after oral intake. So, variety of food would be important to the body rather than only high density nutritional diet.

Keywords: Dysphagia, rehabilitation, muscle, oral intake

SY(T1)12-1

Umami sensing and nutrition

Shizuko Satoh-Kuriwada[1]

1. Tohoku University (Japan)

Decline of taste sense induces not only the decreased quality of life (QOL), but also related to poor nutritional status or health problems have been investigated, particularly in the elderly. Our previous study has shown that elderly people with dysgeusia had a significantly lower frequency of food intake, including meat, fish, legumes, vegetables, and so on, than those with normal taste sensation. Anorexia and poor health were significantly more common in these older people with dysgeusia. Whereas patients with taste disorder often complain about the low palatability of food, even after four basic taste sensation (sweet, salty, sour, and bitter) have improved by clinical treatment. Umami is a unique taste modality, which is the fifth basic taste quality, implicated the palatability and acceptability of foods. It is also considered to be the essence of deliciousness. The patient's complaint might be due to umami taste defect, but umami sensation was not usually measured clinically. We developed the umami sensitivity test using filter paper disc method, and reported the specific decline of umami taste sensation in the elderly patients, which complained of taste problem although four basic tastes other than umami taste were normal. These studies further demonstrated that the umami taste dysfunction also related to appetite and weight loss, resulting in poor health. We tried to find the oral cause of the taste disorder. Dry mouth is also strong causative factor to evoke the taste disorder based on our previous study that showed the rate of salivary secretion was significantly less in the elderly with gustatory impairment than those in normal subjects of the same age group. Moreover, our clinical studies indicated that the treatment for dry mouth is often effective against hypogeusia. Saliva assists and influence the detection of taste sense by allowing the diffusion of taste substances to taste receptors, chemical interaction with food substance. Further it contains various organic substances that help maintain general health, such as enzyme, tissue growth factor, secretary IgA, and so on. Since saliva-promoting medication have various side effects, it is often not available to elderly patients with hyposalivation. We investigated and demonstrated that glutamate, which produces umami taste, increased salivary secretion by the gustatory-salivary reflex. Our data suggests that umami sensing might be an effective tool for the relief of dry mouth as well as regain good health without any side effect. A deeper understanding and insight of how to regain and enhance the umami sensing may have impact on the adequate food intake and the amelioration of poor nutritional status, moreover the improvement overall health.

Keywords: Umami sensing, taste disorder, food intake, gustatory-salivary reflex, overall health

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)12-2

Low calorie sweeteners; Individual and group efficacy for weight management

Rick Mattes[1]

1. Purdue University (USA)

Sweetness is an inherently pleasant sensation and a driver of food intake. In an era when overweight and obesity are prevalent globally, many have expressed concern about the role of sweet foods and beverages in promoting positive energy balance. The US Dietary Guidelines, World Health Organization and others have recommended reducing sugar intake. One approach is to replace nutritive sweeteners with low calorie sweeteners (LCS). Numerous epidemiological studies and clinical trials have examined their efficacy at moderating energy intake and body weight. Findings have been mixed. Some have suggested that LCS are actually counter-productive because they stimulate appetite. The most commonly proposed mechanism is through disruption of carbohydrate metabolism. However, the preponderance of evidence does not indicate that LCS alters either post-prandial glycemia or appetite. Similarly, energy intake is usually lower with LCS use. Multiple meta-analyses of prospective cohort studies assessing indices of body weight (e.g., weight, BMI, waist circumference) have been undertaken. Some have revealed LCS use is associated with slightly higher BMI (but not body weight), while other analyses fail to find an association with either outcome. The strongest meta-analyses of randomized clinical trials consistently document that LCS use leads to lower BMI, fat mass, and waist circumference in children and adults. Whether LCS use is superior to water as a substitute for nutritive sweeteners is not established. Several meta-analyses have suggested LCS use is associated with higher BMI, but these analyses are generally more limited in scope and include trials of questionable methodology. One explanation for the lack of consensus about LCS use and indices of adiposity may relate to the failure to carefully define the LCS studied. It is widely assumed that all commercially-available LCS are functionally equivalent. They all provide sweetness at concentrations so low that they provide little or no energy. However, they are all unique chemicals that are differentially digested, absorbed and metabolized. Consequently, it might be hypothesized that they will have different effects on body weight. Recent work supports this view. A 12-week clinical trial contrasting the effects of daily consumption of sucrose, saccharin, aspartame, sucralose and rebaudioside A on body weight revealed saccharin led to weight gain that was similar to that observed with sucrose. In contrast, sucralose led to a reduction of body weight. Replication of this finding and identification of mechanisms is required. Taken together, the evidence indicates LCS may be a useful aid for weight management if used as a substitute for energy-yielding sweeteners.

Keywords: Sweetener, food intake, appetite, body weight, glycemia

Conflict of Interest Disclosure: Mars, Wrigley - Advisory Board

Grain Food Foundation - Advisory Board

Almond Board of California - Research support

SY(T1)12-3

Olfactory dysfunction is related to frailty and cognitive dysfunction in the elderly

Takaki Miwa[1]*, Shigeto Morimoto*[1]*, Osamu Iritani*[1]

1. Kanazawa Medical University (Japan)

Aim: Individuals with olfactory or gustatory impairment often have associated difficulties with food-related activities. As both functions decline in older adults, we investigated the association of these impairments with sarcopenia/frailty indexes in community-dwelling older adults.

Methods: A total of 141 participants (69 men and 72 women, mean age 73.0 years) were enrolled. Odor identification was examined using the Open Essence test. Salty and sweet tastes were assessed using a whole-mouth gustatory test. Participants underwent evaluation of the appendicular skeletal muscle mass index (ASMI) by InBody720 and grip strength, and determination of the Study of Osteoporotic Fractures frailty index.

Results: Participants with olfactory impairment (Open Essence <7), but not with gustatory impairment, showed a significantly higher prevalence of ASMI and grip strength less than the cut-off values recommended by the Asian Working Group for Sarcopenia, and Study of Osteoporotic Fractures frailty and/or pre-frailty status, compared with those without impairment. Multivariate logistic regression analysis showed a significant association of olfactory impairment with ASMI less than the cut-off value, grip strength less than the cut-off value, Asian Working Group for Sarcopenia sarcopenia and pre-frailty/frailty in the Study of Osteoporotic Fractures index in the whole population, and with ASMI less than the cut-off value and Asian Working Group for Sarcopenia sarcopenia in women, after adjustment. Three (Japanese cypress, wood and roasted garlic) and four (Japanese orange, India ink, menthol and curry) Open Essence odorants were elucidated as the “sarcopenia subset” and “frailty subset,” respectively, and showed higher ability to identify sarcopenia and frailty status, compared with the remaining five odorants.

Conclusions: These findings suggest that olfactory impairment is closely associated with sarcopenia and/or frailty in community-dwelling older adults.

Keywords: Olfactory impairment, frailty, sarcopenia

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)12-4

Changes and Mechanisms of Chronic Psychosocial Stress and Nutritional Preference

Hong Wang[1], Nancy Ellen Rawson[1]

1. Monell Chemical Senses Center (USA)

Obesity is a risk factor for a variety of illnesses. Human studies have linked stress exposure to binge eating and obesity. However, the mechanisms that drive stress-induced overeating remain incompletely understood. The sense of taste plays important roles in food preference and intake. Moreover, taste receptors are expressed in subsets of gut epithelial cells and regulate gut nutrient sensing and metabolism. Altering the sense of taste or taste-receptor-mediated mechanisms in gut may change food preference and intake and lead to weight gain. The goal of this study is to investigate whether chronic stress impacts the peripheral taste system and taste receptor expression in gut. Here, we used a chronic social defeat stress model that had been shown to induce binge eating and weight gain. Our results showed that chronic social defeat stress markedly increased the circulating levels of corticosterone, the main stress hormone. Stress also stimulated food and water intake and led to increased weight gain over time. Chronic stress significantly decreased the mRNA levels of several taste receptors and taste signaling molecules in taste buds. Immunostaining experiments showed that stress decreased the level of KCNQ1, a pan taste cell marker and a voltage-gated potassium channel. Stress also reduced the number of taste bud cells stained positive for PLC-β2, a marker for type II taste receptor cells and a signaling protein required for sweet, umami, and bitter taste signal transduction. These results suggest that stress may interfere with taste signaling and decrease taste sensitivity. Indeed, in behavioral tests, stress decreased the sensitivity and responses to umami taste compounds. In gut, chronic stress altered the expression levels of T1R taste receptors and their downstream signaling proteins. Moreover, we found that monosodium glutamate can reduce chronic-stress-induced weight gain. Together, our results indicate that chronic social defeat stress significantly impacts the peripheral taste system and may also affect taste receptor-mediated mechanisms in gut. These effects of stress likely contribute to the altered food intake and weight gain associated with chronic stress.

Keywords: Stress, Weight gain, Taste receptors, Taste buds, Gene expression

Conflict of Interest Disclosure: This project was supported by a grant from Ajinomoto Co., Inc.

SY(T1)13-1

Health Emergency and Disaster Risk Management (Health EDRM): WHO initiative to promote global collaboration to improve research and evidence

Ryoma Kayano[1]

1. World Health Organization Centre for Health Development (Japan)

World Health Organization (WHO) has taken initiatives to develop and support the implementation of health emergency and disaster risk management (Health EDRM) by countries and support the implementation of country strategies, the Sendai Framework, International Health Regulations (2005), the Sustainable Development Goals (2015), and Paris Agreement on Climate Change (2016) and other related regional and global frameworks. The Health EDRM Framework, published by WHO in 2019, describes all the functions that are required across multiple disciplines in health and other sectors that reduce hazards, vulnerabilities, and exposures, while ensuring effective preparedness and readiness, response, and recovery to save lives, protect health and build community and country resilience. Evidence and research play vital roles in advancing all aspects of Health EDRM including understanding community risks, informing the design and delivery of health and related services, health workforce development and monitoring and evaluation. In order to improve the scientific evidence for Health EDRM and promote global and regional collaboration among researchers and experts, WHO established the WHO Thematic Platform for Health EDRM Research Network (Health EDRM RN) in 2018. The Health EDRM RN has supported the setting of key research themes which has informed WHO Health EDRM research funding over the past 3 years, and the publication of the WHO Guidance on Research Methods for Health EDRM in 2021, which was developed through the collaboration among over 100 global experts. In the context of identifying and applying the lessons from the COVID-19 pandemic and other emergencies and disasters, the Health EDRM RN will continue to strengthen multi-disciplinary including nutritional science and multi-sectoral collaboration, Health EDRM research capacities and translating the evidence base into policy and practice. In view of the progress made by the Health EDRM RN and the shifting global situation, two major projects are underway: the 2nd phase of the WHO Health EDRM Knowledge Hub · the elaboration of research priorities for Health EDRM. The opportunity to provide wider understanding of the WHO Health EDRM policy, practice and several advanced research areas is important for disaster risk management. The WHO Health EDRM Research Network provides effective multi-disciplinary and multi-sectoral collaboration for engagement in development of policy, practice and research. An opportunity to join the Research Network is shared.

Keywords: Health emergency and disaster risk management, Health EDRM, Sendai Framework, Disaster risk reduction, Disaster risk management

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)13-2

Frontiers in Disaster Nutrition for Nutritional Health Care after Natural Disaster and Pandemics

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1. National Institutes of Biomedical Innovation, Health and Nutrition (Japan)

Large-scale natural disasters frequently result in mass evacuations. During these evacuations, nutritional health care may be crucial for sustaining the lives of evacuees. To find scientific evidence of dietary improvement methods at emergency shelters worldwide a literature search was conducted. The literature search yielded seven articles. Four major factors associated with nutritional problems after natural disasters were identified from the literature review: 1) shelter size and equipment of the emergency shelter, 2) the method of provision and content of meals in emergency shelters, 3) collaboration with professionals, and 4) cooperation between shelters.

In addition, we organized the information regarding initiatives taken to improve health and nutrition after natural disasters by governments, professional organizations, and academic research organizations in Japan. After the Great East Japan Earthquake (GEJE), various initiative aimed at health and nutrition improvement after natural disasters, such as establishment of a specialized section, initiative/strategy to stockpile disaster food, development of human resources, and the nutrition standards for disasters, were started in Japan. In this symposium, I would like to introduce various approaches in Japan for solving nutritional health problems at the time of disaster.

1. Global Disaster Nutrition Section/ National Institute of Health and Nutrition.

The mission is to reduce nutrition and health problems according to natural disasters with a slogan of "Evidence to Action". (1) Research for reducing nutritional disparity according to natural disaster, (2) Develop nutritional support system during disaster, and (3) Provide information and logistic support.

2. Disaster Food Certification. Japan Disaster Food Society started a certification system of “Japan Disaster Food” in 2015. Disaster foods are extensions of daily diets. All the foods and drinks conservable at room temperature are available as disaster food. Now, more than 132 items are already certified.

3. Disaster Dietitian.

To provide nutritional health care at actual sites within the disaster-affected areas, the Japan Dietetic Association established the Japan Dietetic Association-Disaster Assistance Team (JDA-DAT). Such systematic and large-scale dietary support after a disaster is rare, even worldwide. Nutritional health care of evacuees could be partially improved by being better prepared for disasters.

Keywords: Nutrition, food, disaster, dietitian

SY(T1)13-3

Addressing Malnutrition in Humanitarian Emergencies

Abigail Perry[1]

1. World Food Programme (Italy)

The three Cs, conflict, climate change and the impacts of COVID-19 are driving alarmingly high levels of food insecurity and malnutrition. In the last two years, the number of food insecure people increased from 135 million to 283 million and is expected to increase further. The global caseload of acute malnutrition is expected to increase by 20 percent. The World Food Programme estimates that at the start of 2022 there are 33.7 million people in Integrated Food Security Phase Classification-4 or higher and just over 10 million suffering acute malnutrition in countries facing acute crises.

With nutrition crises at an all-time high, amalgamation of the ‘three Cs' has echoed the urgent need to pursue more efficient and agile methods to reaching those most at risk in disaster settings. At a time of compounding needs worldwide, the demand for safe and sustained humanitarian access is paramount to ensuring lifesaving humanitarian assistance. The ability to access catastrophe struck communities during the height of the disaster has been one of the most recurrent challenges for humanitarian action.

Vulnerable countries and communities are already suffering from severe losses and damages to lives, livelihoods, crops, and infrastructure caused by the impacts of climate change while there are also other nations where the primary driver of acute hunger is conflict and insecurity. A clear example of climate effects can be seen in Madagascar, where multiple intense cyclones during the agricultural season have the alarming propensity to wipe out harvest, send food prices soaring and increase food insecurity. Whereas In Yemen, changing policies and regulations on fuel supply, telecommunications and transportation facilities have further restricted the ability of WFP and fellow humanitarian actors to deploy and respond.

The crux to the problem is exploring better preparedness through pinpointing how to provide timely humanitarian interventions while concurrently building resilience for populations that are suspectable to disasters. This would require a galvanized efforts from different actors in the humanitarian space.

The presentation ‘Addressing Malnutrition in Humanitarian Emergencies' will delve into the importance of identifying the needs of the most vulnerable, how early warning systems can be used as a tool to combat malnutrition in emergencies and crucial lessons that can be drawn from the World Food Programmes' operation responses in Madagascar and Yemen.

Keywords: Malnutrition, Emergency, Climate, Humanitarian Assistance, Disasters

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)13-3

Addressing Malnutrition in Humanitarian Emergencies

Abigail Perry[1]

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Keywords: Malnutrition, Emergency, Climate, Humanitarian Assistance, Disasters

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)14-1

Protein modification by non-enzymatic glycation and its relevance to lifestyle-related diseases

Ryoji Nagai[1]*, Hiroko Yamaguchi*[1]*, Nana Katsuta*[1]*, Yuki Tominaga*[1]*, Sayuri Kato*[1]*, Yoshitaka Hiraoka*[1]*, Yu Sato*[1]*, Himeno Takahashi*[1]*, Shintaro Kuribayashi*[1]*, Hikari Sugawa*[1]

1. Tokai University (Japan)

Non-enzymatic glycation was first reported in the field of food chemistry as a condensation reaction between reducing sugars and amino acids. This reaction is also called "glycation" and generates the advanced glycation end-products (AGEs) in an advanced stage. This reaction progresses not only in processing foods but also in physiological conditions. Although AGEs formation was believed to progress mainly from glucose, several carbonyl compounds such as methylglyoxal, glyoxal, dehydroascorbic acid, and glycolaldehyde are also reported to play an important role in AGEs formation *in vivo*. However, the detection of AGEs in physiological samples is still difficult and many studies over- or under-estimate AGEs levels in samples, and some other studies brown pigments are mistaken for AGEs. The quantification of AGEs *in vivo* was originally performed using the fluorescent characteristics of AGEs. Subsequently, an anti-AGE antibody was developed as a more specific tool for detecting AGEs, and the involvement of AGEs in various diseases has been reported. However, it is still difficult to clarify the relationship between pathology and glycation by measuring only a single AGE structure. Therefore, monitoring for multiple AGEs in biological samples by instrumental analyses, such as liquid chromatography tandem mass spectrometry (LC-MS/MS), is widely used to assess the biological significance of AGEs. However, LC-MS/MS analysis requires multiple preparation steps before the analysis can be performed and it is difficult to run a large number of clinical samples. For this reason, we developed a device, called the AGE sensor, that detects skin fluorescence intensity. The results using this sensor indicated that the fluorescence intensity at the fingertip was increased in the presence of diabetic microvascular complications. This device allows us to estimate the subject's AGE levels in one minute and the involvement of AGEs in various pathological conditions is currently being investigated. Therefore, I would like to explain the advantages and disadvantages of this simple analysis and the precise analytical methods used for AGEs.

Keywords: Glycation, AGEs, Post-translational modification, aging, diabetic complications

SY(T1)14-2

Novel prevention of disease based on metabolomic aspects on glycation

Reiko Inagi[1]

1. The University of Tokyo (Japan)

Protein homeostasis, which is orchestrated by protein synthesis, folding, modification, and degradation, is essential for cellular function. Glycation is one of the protein modifications that alter protein homeostasis. Advanced glycated proteins, including advanced glycated end-products, often contribute to the development/progression of various diseases associated with metabolic abnormality and aging. The recent studies highlight the link between glycation and metabolism-related organelle function: glycation implicates the metabolic abnormality via organelle dysfunction. In addition, advanced multi-omics analysis has revealed that proteomic and metabolomic analysis shed light on the pathophysiological impact of mitochondrial dysfunction by glycation in diabetic or age-related kidney disease (1).

Meanwhile, organelle dysfunction, such as mitochondrial or endoplasmic reticulum (ER) stress, is a causal factor for cellular dysfunction, leading to disease progression. In kidney disease, organelle stress in tubular cells aggravates tubular inflammation and tubulointerstitial fibrosis, and that in glomerular cells causes severe proteinuria. Notably, such organelle stress is closely associated with metabolic alteration, including glucotoxicity and lipotoxicity (2,3). The recent intensive research, including ours, has revealed how ER stress alters fatty acid metabolism via dysregulation of mitochondrial function, suggesting the pathogenic importance of the link between organelle stress and cellular metabolism (3,4). Interaction of an organelle with another organelle, so-called organelle crosstalk, is an updated research field to reveal new insight into metabolic homeostasis. Our recent studies point out that mitochondrial damage associated with metabolic derangement causes ER-mediated tubular inflammation via mitochondrial DNA leakage into the cytosol (5) and that the mitochondria-ER axis, as well as the mitochondria-primary cilia axis, is essential for homeostatic mitochondrial metabolism (6-8). These results demonstrate that organelle crosstalk determines cell fate from the point of view of intracellular metabolism.

This presentation will summarize the most recent evidence on glycation and organelle stress, both associated with defective organelle crosstalk and metabolic alteration in kidney disease, especially chronic kidney disease (CKD), including diabetic kidney disease related to high glycation status.

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Keywords: Kidney disease, Lipid metabolism, Mitochondria metabolism, Endoplasmic reticulum stress

Conflict of Interest Disclosure: I have the following relationships to disclose.

1) Honoraria and advisory fees: Kyowa Kirin, Astellas, MSD, Chugai, Alexion, Behringer Ingerlheim, Mitsubishi Tanabe

2) Research funding: Kyowa Kirin, Nipro

Further Collaborators: None

SY(T1)14-3

Glycation reaction and the receptor for advanced glycation end-products (RAGE): foe or friend for life?

Yasuhiko Yamamoto[1]

1. Kanazawa University (Japan)

As for sources of energy for life activities, glucose is the most crucial in all livings. Glucose is provided from foods and produced by nutrient metabolism in the body. Nonenzymatic glycation reactions occur between glucose and biological macromolecules *in vivo*. Therefore, glycation is an unavoidable background reaction in living organisms. The final products of the irreversible glycation reaction are called advanced glycation end-products (AGEs). The endogenously formed AGEs are well-known to be bioactive and detrimental to human health. In addition, exogenous AGEs derived from foods are debated to contribute to the development of aging and life-style related diseases. AGEs-induced activation of different signaling pathways is known to be mediated by a cell surface receptor, named the receptor for AGEs (RAGE). RAGE also binds other ligands such as S100 proteins, lipopolysaccharides (LPS), high mobility group box (HMGB)-1, and amyloid-β, relating to inflammation, diabetes, aging-related diseases, cancer development, and Alzheimer's disease; it is now recognized as a pattern-recognition receptor. A growing body of evidence indicates that RAGE can play an important role in pathological steps of disease development and progression, as well as in physiological processes, including tissue regeneration, host defense, apoptotic cell clearance, and nurturing the mother–infant bond. It is also known that RAGE has several isoforms. Membrane-bound full-length RAGE (mRAGE) is the signal transduction form expressed on the cell surface. Soluble

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

forms of RAGE (sRAGE) include endogenous secretory RAGE (esRAGE), a product of an alternatively spliced mRNA, and an ectodomain-shed form of mRAGE. The sRAGE functions as decoys for mRAGE and potentially protects against mRAGE-mediated cytotoxicity. Therefore, the imbalance between mRAGE and sRAGE would lead to morbidity risk and the development of pathological conditions. **These above-mentioned pathophysiological roles of glycation reaction and RAGE will be presented and discussed.**

Keywords: Glycation, advanced glycation end-products (AGEs), receptor for AGEs (RAGE)

SY(T1)15-1

Offspring obesity prevention in pregnancy

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Maternal lifestyle during pregnancy and early nutrition and environment of their offspring´s are considered relevant factors for childhood obesity preventative efforts. In parallel with the increase of overweight and obesity prevalence in childhood, several prenatal factors that are associated with the development of infant adiposity such as prematurity and low birth weight, gestational diabetes, excess body mass gain during gestation, infant formula feeding, etc. have also raised their incidence in the last decades. Interestingly, the rise in the incidence of these perinatal risk factors have also been more pronounced in the developing than in developed countries. We will examine and interpret the knowledge on the early determinants of childhood obesity development in order to provide relevant strategies for daily clinical work. For this purpose, we have evaluated all the identified prenatal factors potentially associated to child adiposity from conception up to the end of the second year of life. Actions to be considered are promoting healthy nutrition and healthy weight status at reproductive age and during pregnancy in order to prevent early excessive weight gain in the offspring. Gynecologists and other health care professionals as midwives should provide proper scientific individual nutritional advice to families to counteract excessive adiposity in the babies. We provide information to help setting up public health strategies to offspring obesity prevention in pregnancy.

Keywords: Pregnancy, Obesity, Prevention, Gestational weight Gain, Gestational Diabetes

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SY(T1)15-2

Epigenetic mechanisms involved in childhood obesity development

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Obesity is the most prevalent nutrition-related chronic condition worldwide. In children, the combined overweight and obesity prevalence is very high in all the countries, especially in those from the Mediterranean region, such as Spain. Obesity seems to have its origin from conception. Understanding the early life mechanisms involved in its development would allow developing early prevention strategies. Epigenetics refers to changes in gene function, not resulting from the primary DNA sequence, influenced by the environment. It provides a link between the molecular regulation of the genome and the environmental signals exposed during the life of individuals (including lifestyle, social behavior, development, and nutrition). Epigenetics could provide new information for the understanding of disparities in the emergence of childhood obesity. Currently the study of obesity epigenome focuses mainly on the analysis of ADN methylation patterns. In the recent years multiple epigenome-wide association studies (EWAS) analyzed thousand of DNA methylation at CpG sites and its potential relationship with common obesity and clinical variables related to the disease and adipose tissue distribution. Multiple CpGs have been identified to be involved in insulin and glucose metabolism, adipogenesis or low grade inflammation development in obese subjects. Although most of these studies used whole blood samples, a direct causal link between DNA methylation and circulating protein levels through regulation of white blood cell gene expression could be possible. The realization of EWAS in peripheral blood of children and its relationship with obesity is of great interest both for the study of the influence of maternal obesity and for the detection of epigenetic markers in childhood in order to make an early diagnosis of development of the disease and its metabolic complications. Several studies have demonstrated the stability of epigenetic marks in the form of ADN methylations during the first years of life, as well as the influence of environmental factors during pregnancy. The objectives of this communication are: 1)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

to understand the molecular basis of the regulation of gene expression through epigenetic modifications. 2) to describe the main results of epigenome-wide association studies in peripheral blood associated with obesity and comorbidities in both adults and children.

Keywords: Obesity, children, epigenetic, dna methylation
Conflict of Interest Disclosure: None

SY(T1)15-3

Immune system and microbiota in obesity

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Obesity is a serious public health concern that is alarmingly growing in the population around the world. It is widely accepted that high levels of body mass index (BMI), comprising a high range between overweight and obesity, can promote a risk of developing non-communicable diseases, such as metabolic syndrome, cardiovascular and musculoskeletal disorders, type 2 diabetes, non-alcoholic fatty liver disease, and certain type of cancers, leading to high rates of mortality. Indeed, obesity and its comorbidities are characterized by a low-grade chronic inflammation status. On the other hand, according to the research in the last decade, there must be an interaction between nutrients and the gut microbiota; therefore, gut microbes might play a crucial role in the regulation of host metabolism and the function of the immune system. Thus, in the context of obesity and related metabolic diseases, the gut microbiota could be proposed as an interesting therapeutic target to avoid inflammation disorders. In addition, microbiota may contribute to significantly facilitate food digestion through enriching genes in metabolizing carbohydrates, vitamins, short-chain fatty acids and amino acids, leading to homeostasis, as well as to a balanced energy metabolism and immunological status. The colon is well-known to contain the highest density of microbes, so that easily sampled using faeces is the most widely studied gut site to evaluate microbiota composition and the risk of obesity. High fat/carbohydrate ratio diets are capable to programme gut microbiotas predominating Firmicutes (Clostridium), Prevotella and Methanobrevibacter, although deficient in beneficial genera/species such as Bacteroides, Bifidobacterium, Lactobacillus and Akkermansia. Reduced amounts of beneficial microorganisms also inhibit fasting induced adipocyte factor expression leading to dyslipidemia. Moreover, altered gut microbiota is associated with decreased expression of short-chain fatty acids that maintain intestinal epithelial barrier integrity, reduce bacterial translocation and inflammation, and an increased expression of hunger-suppressing hormones. In this sense, the synergy of high-fat diets and dysbiosis could be responsible of a recipe that epigenetically programmes the host for an increased adiposity as well as serious inflammation processes.

Keywords: Obesity, Immune system, Microbiota, Chronic inflammatory diseases, Nutrition

SY(T1)15-4

Mediterranean lifestyles protecting children from obesity

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Childhood obesity is the most prevalent nutritional disorder during childhood. It develops in individuals with a genetic predisposition substrate and the presence of factors related with nutrition, sedentary behaviours and others as short sleep duration. Identifying the risk factors associated with obesity, as well as quantifying the risk of each of them, is essential to understand a multifactorial problem such as childhood obesity. We have developed a randomized controlled multi-centre clinical trial (Meli-Pop), in a cohort of children aged 3 to 6 years at baseline and being at obesity risk. The main objective consists on assessing the efficacy of an intervention during early childhood, considering a healthy lifestyle based on the promotion of a Mediterranean dietary pattern and regular physical activity, compared with a control group, on decreasing obesity incidence 5 and 10 years after the beginning of the intervention. Children, aged 3 to 6 years, having at baseline a body mass index (BMI) <; than the equivalent to 30 kg/m^2 in adults, and the mothers having a BMI >; 30 kg/m^2 are considered for inclusion. The clinical trial has two arms and it has been performed in Primary Health centers in 3 Spanish cities: Córdoba, Santiago de Compostela and Zaragoza. The control group will receive usual care by healthcare professionals. The intervention group receive education on Mediterranean lifestyle (Mediterranean diet and physical activity promotion), combined with the provision of extra-virgin olive oil and fish, in order to be consumed at least 3 times per week. Physical activity sessions with a physical activity monitor are also offered for free to the children (3 sessions of 60 minutes of moderate-vigorous physical activity, per week). Interventions trying to prevent obesity should start as early as possible as the possibility to positively influence its progress is optimal in this period.

Keywords: Obesity, Child, Mediterranean diet, Prevention
Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T1)16-1

Postbiotics is a new era for health science

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Research on the effects of dietary components on health has been conducted for a long time, but recently, attention has also been focused on microbiome especially commensal bacteria in the gut. Probiotics (beneficial bacteria for our health) and prebiotics (food for useful bacteria) have already been put to practical use and thus well known, but recently, "postbiotics" has been attracting attention as a new concept. Postbiotics are metabolites originated from dietary components and produced by microorganisms, and after being absorbed into the body, they affect various health conditions. The concept of postbiotics would lead to the research upgrade to consider the production of postbiotics through the crosstalk between dietary components and microorganisms. In this talk, I would like to introduce our recent findings on postbiotics, including the integration of analytical technologies such as metabolomics and metagenomics, basic research using animal models and microbial culture systems, and human research using various information and samples obtained individuals at various areas in Japan.

Keywords: Postbiotics, Health science, metabolites, Mice, Human

Conflict of Interest Disclosure: Some results were obtained as a collaboration with Noster Inc and Nippn Inc.

SY(T1)16-2

Maintenance of gut homeostasis by food and probiotics

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The mammalian gastrointestinal tract, the site of digestion and nutrient absorption, is home to a microbial ecosystem that enhances resistance to infection, inflammation, allergy, and metabolic diseases. Commensal bacteria are key participants in the digestion of food, and are responsible for the extraction and synthesis of nutrients and other metabolites that are essential for the maintenance of mammalian health. Over the past decade, the connection between various disorders and gut microbiota has become a major focus of biomedical research. Because of the complexity of the microbiota community, however, the underlying molecular mechanisms by which the gut microbiota is associated with diseases remain poorly understood. Dietary signals are known to modulate stemness and tumorigenicity of intestinal progenitors; however, the impact of a high-fat diet (HFD) on the intestinal stem cell (ISC) niche and its association with colorectal cancer remains unclear. In this talk, I summarize recent studies how HFD affects the ISC niche and its regulatory factors.

Keywords: Gut microbiota, high-fat diet, intestinal stem cell, colorectal cancer

SY(T1)16-3

The importance of nutrition considering the function of the indigenous microbiota in the gut

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The human intestinal tract contains the gut microbiota, a mixture of more than 150 bacterial species, which contains several tens of trillion bacterial cells, equivalent to the number of human cells, and weighs as much as 1 kg. Recently, the gut microbiota has been found to have a significant impact on diseases related to the energy balance of the human body, such as obesity and diabetes. This suggests that the gut microbiota plays an important role in the nutritional acquisition of the human host, and the idea that "gut microbiota is another organ" is gaining popularity. Probiotics, which are defined as live bacteria that are ingested to improve the intestinal environment, influence the gut microbiota. Also prebiotics is defined as a substrate that is selectively utilized by host microorganisms conferring a health benefit. Prebiotics are widely used as commercial ingredients to modify gut microbiota. However, certain existing prebiotics meant to facilitate the growth of beneficial bacteria in the intestine also promote the growth of other prominent bacteria. Therefore, the growth-promoting effects of β-galactosides on intestinal bacteria were analyzed. Galactosyl-β1,4-l-rhamnose (Gal-β1,4-Rha) selectively promoted the growth of Bifidobacterium. Bifidobacterium longum subsp. longum 105-A has multiple solute-binding proteins belonging to ATP-binding cassette transporters for sugars. Each strain in the library of 11 B. longum subsp. longum mutants, in which each gene of the solute-binding protein was disrupted, was cultured in a medium containing Gal-β1,4-Rha as the sole carbon source, and only the BL105A_0502 gene-disruption mutant showed delayed and reduced growth compared to the wild-type strain. BL105A_0502 homolog is highly conserved in bifidobacteria. In a Gal-β1,4-Rha-containing medium, Bifidobacterium longum subsp. infantis JCM 1222T, which possesses BLIJ_2090, a homologous protein to BL105A_0502, suppressed the growth of enteric pathogen Clostridioides difficile, whereas the BLIJ_2090 gene-disrupted mutant did not. In vivo, administration of B. infantis and Gal-β1,4-Rha alleviated C. difficile infection-related weight loss in mice. We have successfully screened Gal-β1,4-Rha

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DOI: 10.1159/000530786

as a next-generation prebiotic candidate that specifically promotes the growth of beneficial bacteria without promoting the growth of prominent bacteria and pathogens. The gut microbiota, "another organ", converts various diet-derived compounds entering the colon into other compounds. These are gut bacteria-derived metabolites, which have recently been reported to have a variety of effects on the host. Colonic luminal aromatic amines have been historically considered to be derived from diet, however recent studies indicate that the gut microbiota serves as an alternative source of these amines. Herein, we show that five prominent genera of Firmicutes (Blautia, Clostridium, Enterococcus, Ruminococcus, and Tyzzerella) have the ability to abundantly produce aromatic amines through the action of aromatic amino acid decarboxylase (AADC). In vitro cultivation of human fecal samples revealed that significant positive correlation between aadc copy number of Ruminococcus gnavus and phenylethylamine production. Furthermore, using genetically engineered Enterococcus faecalis-colonized mouse model, we showed that the gut bacterial aadc stimulates the production of colonic serotonin, which is reportedly involved in osteoporosis and irritable bowel syndrome. Finally, we showed that human AADC inhibitors carbidopa and benserazide inhibit phenylethylamine production in En. faecalis.

Keywords: Prebiotics, Probiotics, Gut bacteria-derived metabolites, Phenylethylamine, Serotonin

SY(T1)17-1

Antioxidant function of *Chlorella* in our body

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Accumulation of phospholipid hydroperoxide (PLOOH) as a result of oxidative stress in erythrocyte membranes is found typically in patients with senile dementia, including those with Alzheimer's disease (AD). Lutein as xanthophyll is a major antioxidant present in erythrocyte membrane, and it is confirmed that erythrocyte lutein concentration is lower in AD patients than in control subjects. Green algae *Chlorella pyrenoidosa* is rich in protein and dietary fiber and is known to be particularly high in lutein. We conducted a randomized, double-blind, placebo-controlled human trial to assess the impact for a total of 2 months *Chlorella* supplementation (8 g *Chlorella*/day/person, equivalent to 23 mg lutein/day/person). After the treatment, erythrocytes and plasma lutein concentrations increased in the *Chlorella* group but not in the placebo group, and in the *Chlorella*-supplemented group, erythrocyte PLOOH after 2 months of treatment were lower than the concentration before supplementation. The findings suggest that *Chlorella* ingestion improved erythrocyte antioxidant status and lowered the aged erythrocytes rich in oxidized lipids in our body. *Chlorella* total intake rich in lutein might contribute to maintaining the normal function of erythrocytes and prevent the development of senile dementia.

Keywords: Chlorella, Lutein, Senile dementia, Alzheimer's disease, Erythrocytes

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T1)17-2

Capability of Chlorella as a Protein Source

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Health issues as lifestyle diseases, *e.g.*, diabetes, cancer, stroke, and cardiovascular disease, derived from excessive food intakes and lack of exercise, are serious problems in the developed countries. However, famines have still been one of the most serious issues in the developing countries. It is required to develop novel healthy plant protein sources due to resolving this food crisis because it was reported that animal proteins were not necessarily adequate protein sources based on cholesterol homeostasis compared with plant proteins. Thus, utilization of plant proteins, soybean protein, algae protein and so on, have been studied as alternative protein sources.

Chlorella is one of the microalgae and a high protein foodstuff which the protein content is as much as 60%. Chlorella protein has a superior essential amino acids balance and is recognized as a potential novel alternative protein source. However, a rigid cell wall in chlorella constricts the utilizing beneficial components in the cell. Thus, it was required to develop an effective cell wall breaking treatment and then the treatment with DYNO-MILL was developed. After this treatment, over 90% cell wall was broken down and the digestibility in treated chlorella was improved compared with one in untreated chlorella. However, it was unclear whether the protein digestibility in the treated chlorella was superior to other food proteins. Thus, we attempted to clarify whether the protein digestibility in the treated chlorella was superior to other food proteins, soybean protein, rice protein, and gluten. From the *in vitro* digestion test using pepsin and pancreatin, the chlorella protein was almost digested after 4 hours and its digestibility was superior to one of soybean protein and rice protein. Chlorella protein with broken cell wall was digestible and accessible as an alternative protein source.

Although it is shown that chlorella with broken cell wall has a capability as a protein source from our study, it is unclear whether chlorella with broken cell wall has beneficial effects on our health. Thus, we attempted to clarify novel physiological functions of chlorella, especially beneficial effects on atopic dermatitis (AD). Three weeks old female hairless mice were employed and fed the egg white diet with or without 5% chlorella for 15 weeks. After 3 weeks, 1.2% trinitrochlorobenzene application was conducted to evoke AD symptoms. Chlorella intake significantly suppressed the decrease of moisture contents of the skins after 8 weeks. In addition, chlorella intake also significantly suppressed the formation of erythema, one of

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DOI: 10.1159/000530786

the typical AD symptoms. From these results, it is suggested that chlorella had the suppressive effects on deteriorating AD symptoms. These studies show that chlorella has capability as a novel alternative protein source.

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Keywords: Chlorella protein, digestibility, atopic dermatitis

SY(T1)17-3

Immunological Function of Chlorella

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Chlorella is a unicellular green alga growing in fresh water and has widely been used as a dietary supplement with beneficial nutritious content. Among many other potential health benefits, evidence has accumulated that chlorella possess immunological function. Antigen presenting cells such as dendritic cells and macrophages are central players in innate immunity and express pattern recognition receptors (PPRs) including Toll-like receptors (TLRs) to recognize patterns of non-self molecules. Several studies have shown that polysaccharides from chlorella binds TLR2, TLR4 and complement receptors expressed on the cell surface of antigen presenting cells and activates them. We found that extract of chlorella with high contents of polysaccharides induces activation and cytokine production of human and murine dendritic cells via TLR2 engagement. The extract of chlorella also enhanced T cell responses in a co-culture system with dendritic cells. The results suggest that chlorella-derived polysaccharides could stimulate both innate and adaptive immunity. Chlorella extract also reportedly simulates activation of natural killer cells, a principal player in anti-tumor and anti-virus immunity. Studies using murine models have suggested anti-tumor, anti-pathogen, and anti-allergy effects of chlorella. In several clinical experiments on healthy subjects, supplements of chlorella increased the levels of mucosal immunoglobulin A (IgA) in body fluids including saliva and breast milk. Interestingly, extract of chlorella enhances proliferation of human-origin probiotic *lactobacilli*, suggesting that chlorella could be prebiotic to promote the growth of beneficial microbes and contribute to gut-associated mucosal immunity. In this symposium, such immunological functions and potential application of chlorella for better health are introduced.

Keywords: Chlorella, Immunological function
Conflict of Interest Disclosure: None
Further Collaborators: Professor Higuchi Ohki

SY(T1)17-4

Immunological Function of Chlorella The water extracts from the microalgae (*Chlorella pyrenoidosa*) can against dengue virus type II (DENV2) infection

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In this century, the health of human will be challenged by the newly emerged infectious disease, such as AIDS, Avian flu, Dengue and COVID-19. Dengue virus (DENV) is a positive, single-stranded RNA virus with glycoprotein envelope, which caused three outbreaks in Taiwan. DENV infection has been shown an important epidemic disease in Taiwan. Mechanisms of how DENV causes clinical symptoms are not fully understood. Now, there is still no vaccine or antiviral drug in DENV infection, although *in vitro* studies revealed the sulfated polysaccharide from the algae had anti-dengue viral activity. *In vitro* studies, we find that the *chlorella pyrenoidosa* water extracts (CPE) can inhibit viral replication of DENV2 and effectively increase the plaque reduction rate of DENV2. The anti-DENV mechanism studies of CPE have been attributed to a blockade of the virus adsorption and then make the virus unable to enter cells. In the DENV2 infected mice model, these suckling mice appear the typical dengue syndrome, plasma leakage and gastrointestinal hemorrhagic, at the 6th day of post-infection and die at the 11th day of post-infection. The CPE can attenuate hematocrit, thrombocytopenia and gastrointestinal bleeding, and improves survival rate in neonatal mice after dengue virus infection.

Through all these efforts, the CPE may be used as a health food supplement of anti-DENV and immuno-modulatory activity agents.

Keywords: Microalgae, Chlorella pyrenoidosa, Water extracts, Dengue virus, Anti-viral agents

Conflict of Interest Disclosure: None

SY(T2)1-1

The nutritional significance of dietary choline -Introduction-

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Choline is one of Vitamin-related nutrients belonging to the Vitamin B group. Its chemical entity is trimethyl-ethanolamine. Several choline-related compounds, such as phosphor-choline, glycerophosphocholine, phosphatidylcholine and sphingomyelin are contained in foods along with free choline. These dietary choline-related compounds seem to be differently digested, absorbed and metabolized in our body, but the details are not clarified yet. As choline is used for the substrate of acetylcholine synthesis, an important neurotransmitter, biological membrane phospholipids and involved in one-carbon metabolism pathway, suggesting its physiological significance, the recommended daily intake of choline is determined in many countries except in Japan. Choline deficiency is reported to induce the liver steatosis and liver damage. The actual choline intake in normal adults seems to be less than the RDI and the precise intake of dietary choline is now under re-evaluation in several countries and these assessments suggest that the intake of choline is not sufficient as expected. In this symposium, the nutritional and physiological significance of dietary choline is discussed. After introduction of this symposium, the present situation of choline intake in Japan will be introduced following the report of large-scale assessment of the choline intake in USA. These lectures will support the discussion of nutritional aspect of choline and final lecture will be focused on the determination of choline in biological samples and the physiological behavior of choline which help our discussion in the chemical and biological aspects of choline.

Keywords: choline, nutritional assessment, phosphatidylcholine, sphingomyelin

SY(T2)1-2

Current situation of dietary choline in Japan

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Choline is a trimethylaminoethanol with quaternary ammonium ions and is present as a hydrophilic base in such lipids (hydrophobic substances) as phosphatidylcholine and sphingomyelin. Choline is known to have a wide range of biological effects on brain function, liver function, the perinatal period, etc. In particular, Humans can produce a small amount of choline via de novo synthesis, but it is rarely synthesized in organs other than the liver, and the source of choline is mainly derived from dietary sources.

In the United States (Food and Drug Administration), for the adequate intake (AI) of choline, the AI for adults was set at 550 mg/day for men and 425 mg/day for women, based on the results on hepatic function impairment obtained from a choline-deficient diet experiment by Zeisel et al (FASEB J., 5, 2093-2098, 1991). On the other hand, the adverse effects of excessive choline intake include cholinergic side effects (e.g., sweating, diarrhea), fishy odor, and hypotension. For this reason, the upper limit (UL) for adults is set at 3.5 g/day. Incidentally, the AI was set in 2016 in recognition of the benefits of choline at the European Food Safety Authority. In the Eu, AI in adults is set at 400 mg/day and 480 mg/day for pregnant women and 520 mg/day for nursing mothers. In Japan, on the other hand, adequate intake of choline has not been prescribed because it is not yet fully recognized as a nutrient. There is no mention of choline compounds in both the Dietary Reference Intakes for Japanese (2020 edition) and the Standard Tables of Food Composition in Japan (2020 edition).

Therefore, we conducted a weighing survey on 19 female students (aged 20 to 21 years) and 17 male students (aged 19 to 21 years) at University A and University B respectively, by measuring and recording the weight of food consumed in each of their meals over a 3-day period. Considering seasonal variations, the survey was conducted on three consecutive weekdays in April, July, and October 2016, and January 2017. The choline intake was calculated by applying data broken down to a list of choline contents in food materials made publicly available through the United States Department of Agriculture. However, due to differences in the dietary habits of Americans and Japanese, the choline content could be calculated from only about 70% of food ingredients (unpublished data). We estimated the choline intakes under these circumstances. Even after considering these various factors, we believe the value is far from the standard value in the United States. The Japanese consume low amounts of dairy products, and their consumption of livestock products is also quite low compared to other countries. Furthermore, rice with its low choline content is their staple food. This suggests that it may be difficult for Japanese people to consume sufficient amounts of choline compounds in their diet.

Keywords: Choline, vitamins-like material, adequate intake

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T2)1-3

Precision Nutrition: Lessons from studies on the nutrient choline

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The field of precision nutrition is changing how nutrition science is translated into more precise applications for improving the diets of people. Individuals differ in their requirements for and responses to nutrients in the diet. Many inputs contribute to metabolic heterogeneity (including variations in genetics, epigenetics, microbiome, lifestyle, diet intake, and environmental exposure). This presentation will focus on genetic variation and metabolic heterogeneity. Genetic testing can stratify people on the basis of single nucleotide polymorphisms that result in metabolic inefficiencies and then we can use this stratification to better estimate the different subgroups' dietary requirements, thereby enabling better dietary recommendations and interventions. People who have higher dietary requirements for choline can be identified using analyses of patterns of single nucleotide polymorphisms. When these people are fed a diet very low in choline, they develop health probes that include fatty liver and/or loss of muscle tissue. Women with certain patterns of single nucleotide polymorphisms need to eat diets higher in choline and folate to have optimal pregnancy outcomes.

Keywords: Choline, Precision nutrition, single nucleotide polymorphisms

Conflict of Interest Disclosure: Dr. Zeisel has equity in SNP Therapeutics. He is on the scientific advisory board for ByHeart, and for Brainiac Foods.

SY(T2)1-4

Mechanisms and implications for phospholipid fatty acid homeostasis

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Phospholipids, the main component of the biological membrane, contain various types of polar heads and fatty acids. Recent advances in mass spectrometry technology have revealed that phospholipids are composed of thousands of different molecular species with varying head groups and fatty acids. Elucidating these diverse phospholipid species' function and biological significance is not only one of the critical issues in lipid biology. Still, it is also important from a nutritional point of view. Choline and fatty acids are essential for living organisms, and vertebrates, including humans, take in choline and fatty acids from the outside world as nutrition. On the other hand, the type and composition (number of carbons and double bonds) of fatty acids differ between organisms. Therefore, organisms that consume different species as part of their diet will take in fatty acids specific to the species they consume. Excessive sugar and saturated fatty acid intake lead to diabetic conditions. We have found that excessive saturated fatty acid administration, such as palmitic acid (PA), to cells induces an endoplasmic reticulum stress response. It has also recently been found that specific receptor-like membrane proteins hydrolyze PA in PA-containing phospholipids and replace PA with unsaturated fatty acids, thereby contributing to the unsaturation of the membrane and thus preventing diabetic pathology. In this presentation, we will introduce you to our laboratory's lipidomics technology and a novel mechanism for maintaining the homeostasis of fatty acid species in membrane phospholipids.

Keywords: Phospholipid, fatty acid, choline, phosphatidylcholine, Mass spectrometry

Conflict of Interest Disclosure: None

Further Collaborators: Takeshi Ohkubo

SY(T2)2-1

Assessment of reward system among individuals with eating disorders

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Anorexia nervosa and bulimia nervosa share the same core symptoms such as the desire to thinness and the fear of obesity despite very different physical conditions. The etiology and the mechanisms that contribute to the onset and maintenance of these disorders are still unclear, and biology-based treatments have not yet been established. It has been suggested that abnormalities in the reward system of brain, which can explain their clinical characteristics, may be involved in the onset and maintenance of symptoms in both diseases. In other words, the restriction of food intake in AN and binge eating in BN may be recognized as rewards in the brain and lead to the maintenance of behavior, from the possible perspective of "behavioral addiction". Against this background, the brain reward system has become one of the main targets of research to elucidate the pathogenesis of eating disorders. In this presentation, I will review the topics regarding brain reward system as the current model for the onset and maintenance of eating disorder, particularly focused on AN. Recently, psycho-biological findings have been accumulating that impairment of the reward system is involved in the persistence of AN symptoms. Findings of structural brain imaging suggest that structural changes in brain regions involved in the reward system may contribute to the pathogenesis of AN. Similarly, functional MRI studies have shown that the brain activity of reward system circuits in the brain of AN patients is distinctive in response to stimulus presentations that may be rewarding to them, such as food stimuli, body image related stimuli, and stimuli related to food intake restriction and overactivity. Furthermore, it is known that patients with AN, as

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DOI: 10.1159/000530786

well as those with mood and anxiety disorders, do not respond adequately to many events that are conventionally perceived as reward, such as food and social interaction. On the other hand, they respond excessively to AN-related behaviors, such as restricting food intake and excessive exercise. These characteristics of responses to rewarding stimuli are likely to contribute to the persistence of AN symptoms. The effect of increased responsiveness to punishing stimuli as well as decreased responsiveness to rewarding stimuli are also pointed out. AN patients show rewarding responses to weight loss behaviors and thinness-related stimuli, but strong aversions to weight gain, social situations, and financial loss. Such responses are easily influenced by context, and clarifying what information and stimuli AN patients perceive as rewards or punishments will provide not only crucial insights into the mechanisms of symptom maintenance but also the important knowledge for more effective practical support. I will discuss the potential of the reward system in the brain as a target for condition assessment and treatment of AN.

Keywords: Eating disorders, Reward system, MRI
Conflict of Interest Disclosure: None
Further Collaborators: None

SY(T2)2-2

Assessment of nutritional status and psychopathology in the treatment of eating disorders with different duration of illness

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Eating disorders (EDs) can become psychologically and physically severe.

Recently, we reported that the physical and psychological characteristics of patients with anorexia nervosa (AN) differed depending on the duration of illness. With regard to physical aspects, although there was no significant difference in body mass index (BMI), it was observed that the total protein, albumin, and potassium levels were significantly lower in patients with a longer duration of illness (>5 years) than in those with a shorter duration of illness (<5 years). The levels of total protein and albumin tend not to decrease in patients with a short illness duration despite a low BMI. Therefore, serum albumin levels may be unsuitable for nutritional assessment, especially in young patients with AN, suggesting the importance of assessing albumin levels in addition to other nutritional biomarkers such as pre-albumin.

Weight recovery is extremely important for the treatment of AN. Clinically, it is not uncommon for clinicians to observe poor weight regain in the early stages of nutritional recovery. In recent years, many studies have reported that the gut microbiota plays an important role in the regulation of weight regain. In a comparison of gut microbiota between 25 patients with AN and age-matched healthy women, the amounts of total bacteria were significantly lower in the AN group than those of the control group. In addition, in a comparison of germ-free mice reconstituted with microbiota from restricting-type AN (AN-R) patients (gAN mice) and age-matched healthy control individuals (gHC mice), gAN mice had poor weight gain and showed higher levels of anxiety than gHC mice. These results suggest that "disbiosis" in some of the pathological conditions such as decreased nutritional efficiency and the onset of psychiatric symptoms is an important finding to be considered in the treatment of AN.
With regard to psychological aspects, the psychopathology of eating disorders in our study was more severe in AN patients with a longer duration of illness (>5 years). Therefore, it is important to develop a strong therapeutic intervention according to disease duration.

In conclusion, appropriate biopsychosocial interventions based on the assessment of physical and psychological aspects according to the duration of EDs are important.

Keywords: Eating disorders, Anorexia nervosa, duration of illness, weight regain, disbiosis

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SY(T2)2-3

Assessment of stage of change and intervention strategies

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One of the difficulties in the treatment of eating disorders is the high level of resistance to treatment and high percentages of treatment dropout. One of the causes of treatment dropout on the part of patient is the problem of motivation. When introducing treatment, it is necessary to evaluate the patient's motivation for treatment and to consider how to motivate the patient for treatment. There are stages of attempting to change one's behavior in order to engage in treatment, and these are described in the Transtheoretical Model of the Stage of Change as a series of stages in which people make typical progress in thinking about, initiating, and continuing new behaviors as theorized by Prochaska and Diclement. The stages of change are structured as a cyclical model consisting of five stages: pre-contemplation, contemplation, preparation, action, and maintenance. Prochaska et al. showed that there is a relationship between the stages of change and the patient's self-change behavior, dropout, and treatment efficacy in addictive behaviors, and it has also been shown to be useful in patients with eating disorders. Depending on which cycle the patient is in, the therapist needs to vary the way to motivate the patient to change her eating behavior. Motivation for change has evolved from the field of substance use disorders (e.g., alcohol, illegal drugs, smoking). Motivation is considered to be multifaceted, dynamic, modifiable, and influenced by social reactions and clinician attitudes and techniques. Miller and colleagues summarized the techniques as Motivational Interviewing, which

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DOI: 10.1159/000530786

has been shown to be useful in the field of alcohol and substance use disorders and has since been applied in the field of eating disorders. The 2017 NICE guideline in the UK lists Maudsly Anorexia Nervosa Treatment for Adults (MANTRA) as one of the recommended treatments for adult anorexia nervosa. The five stages of change and Motivational Interviewing are important techniques incorporated in MANTRA. As for interventions tailored to the stage of change, explanation of disease and psychological education are important in the pre-contemplation stage because of the lack of disease awareness. In the contemplation and preparation stages, techniques from Motivational Interviewing are used, and especially in the preparation stage, the patient is asked to think about the future self. In the action phase, specific behavioral goals and praise for efforts are necessary, and in the maintenance stage, efforts to prevent relapse should be made. I would like to discuss these details on the presentation day.

Keywords: Eating disorder, stage of change, motivational interviewing, dropout

SY(T2)2-4

Assessment and treatment of refeeding phases in eating disorders

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Refeeding syndrome (RFS) is a life-threatening complication of nutritional replenishment in underweight patients with eating disorders (EDs). Refeeding in a malnourished state is thought to serially induce hyperglycemia, hyperinsulinemia, and fluid and electrolyte shifts. It can also lead to refeeding hypophosphatemia (RH). Because phosphate is an essential component of adenosine triphosphate, RH can cause potentially fatal complications. Therefore, RH has been widely used as a criterion of RFS in patients with anorexia nervosa (AN). Risk factors for RH in patients with AN include lower prealbumin levels, lower body mass indexes (BMIs), higher hemoglobin levels, older ages, and higher blood urea nitrogen levels. Based on expert opinion, the National Institute for Health and Clinical Excellence (NICE) guidelines state that individuals with a BMI <16 kg/m2 are at a risk for RFS; however, the exact BMI cut-off point is not known. In addition, lower calorie refeeding as a preventive strategy for RH has been previously investigated. However, there were opposing reports regarding the effectiveness of this preventive measure. It could be too conservative from the viewpoints of poor weight gain and prolonged hospital stay in inpatients with AN. Some experts reported that low-carbohydrate diet administration to inpatients with AN might prevent the occurrence of RH according to their clinical impressions. However, the exact association between carbohydrate content in diet and the occurrence of RH in patients with AN remains unrecognized. Therefore, the aims of the present study was to identify the optimal BMI cut-off point for RH in patients with EDs and to retrospectively examine the association between the ratio of carbohydrate to total energy consumption and the occurrence of RH in inpatients with AN through data extracted from their medical records. Methods: The medical charts of Japanese inpatients with EDs at the Department of Psychosomatic Medicine of the University of Tokyo Hospital between April 1, 2012 and February 29, 2020 were retrospectively reviewed. The optimal BMI cut-off point for RH was determined via receiver operating characteristic (ROC) analysis. ROC analysis was also performed to determine the cut-off point of the percentage of carbohydrate content in the diet for the occurrence of RH. Logistic regression analysis was subsequently performed to assess the association between RH and the BMI cut-off point after adjusting for the propensity score, which was based on known risk factors for RH. Multivariate logistic regression analysis was also performed with occurrence of RH as the dependent variable and the carbohydrate content of more than the identified cut-off point as the independent variable adjusting for the risk factors for RH. Logistic regression analysis was subsequently performed to assess the association between RH and the BMI cut-off point after adjusting for the propensity score, which was based on known risk factors for RH. Results: The optimal BMI cut-off point was identified as 12.6 kg/m2. A BMI lower than the cut-off point significantly correlated with the occurrence of RH after adjusting for the propensity score. The percentage of carbohydrate content that is higher than the cut-off point obtained from the ROC analysis was significantly associated with the occurrence of RH, even after adjusting for variables associated with RH in univariate logistic regression analysis (age and body mass index) as well as the average daily calorie intake. Discussion: The optimal BMI cut-off point for the occurrence of RH was 12.6 kg/m2 in patients with EDs. We also identified that diets with higher carbohydrate contents were associated with RH in inpatients with AN, even after adjusting for known risk factors. The findings of the present study may facilitate clinical decision making and early identification of patients who require prophylactic treatment for RH, and also may promote the development of dietary preventive strategies against RH in inpatients with AN.

Keywords: Eating disorder, refeeding syndrome

SY(T2)3-1

Developing a Food Compass system in Japan

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The Dietary Reference Intakes for Japanese—a unique national nutrient-based dietary guideline in Japan—recommends target amounts of nutrient intakes as the tentative dietary goals (TDG) for Japanese people to reduce the risk of lifestyle-related chronic diseases. Previous research implied that TDG adherence based on the seven nutrients studied has a limited beneficial impact on lifestyle-related chronic outcomes. This finding supports recent nutrition science understanding that the level of each nutrient, independent of the source of the

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DOI: 10.1159/000530786

nutrients, may not necessarily indicate a healthy diet. Foods are more than just a collection of nutrients they contain. A new indicator, dubbed the "Food Compass" by a research team at Tufts University, is a novel nutrient profiling system that assesses the healthiness of foods, using a wider range of food characteristics, attributes, and uniform scoring principles. The Food Compass determines the healthiness of a diet and enables people to choose and consume a healthy diet on an individual level. This presentation will discuss the challenges of developing a Japanese version of the Food Compass and the various Japanese data issues associated with it.

Keywords: Food Compass, nutrient profiling system
Conflict of Interest Disclosure: None

SY(T2)3-2

Food Compass: development and predictive validation of a nutrient profiling system using expanded characteristics for assessing the healthfulness of foods

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Nutrient profiling systems (NPS) aim to discriminate the healthfulness of foods for front-of-package labelling, warning labels, taxation, company ratings, sustainable investing and more. The Food Compass is a novel NPS developed to characterize healthfulness of diverse food and beverage products including mixed dishes and restaurant meals utilizing the same algorithm and scoring system for all products; and incorporating a range of novel positive and negative attributes consistent with the best available new science – a major advance from existing NPS.

The Food Compass algorithm scores 54 attributes across 9 health-relevant domains- nutrient ratios, vitamins, minerals, food ingredients, additives, processing, specific lipids, fiber and protein, and phytochemicals, summed into a final Food Compass Score (FCS) ranging from 1 (least healthy) to 100 (most healthy) for all foods and beverages. Content validity was confirmed by assessing nutrients, food ingredients and other characteristics of public health concern; face validity was confirmed by assessing the FCS for 8,032 foods and beverages reported in NHANES FNDDS 2015-16; and convergent and discriminant validity was confirmed from comparisons with the NOVA food processing classification, Health Star Rating (HSR) and Nutri-Score. Within food categories, the FCS provided important discrimination of specific foods and beverages as compared with NOVA, HSR or Nutri-Score.

In addition, predictive validity was assessed in a nationally representative cohort of 47,999 U.S. adults, by calculating a person's individual Food Compass Score (i.FCS), ranging from 1 (least healthful) to 100 (most healthful) based on the cumulative scores of the specific food and beverages they consumed against three endpoints: (a) the Healthy Eating Index (HEI) 2015, an established measure of a healthy diet; (b) prevalence of major clinical risk factors and health conditions; and (c) prospective risk of all-cause and cause-specific mortality. Nationally, the mean (SD) i.FCS was 35.5 (10.9). i.FCS correlated highly with HEI-2015 (R=0.81), with similar findings among diverse population subgroups. In cross-sectional analysis, after multivariable-adjustment, each one SD (10.9 point) increase in i.FCS was associated with more favourable BMI (-0.60 kg/m^2 [-0.70, -0.51]), systolic blood pressure (-0.69 mmHg [-0.91, -0.48]), diastolic blood pressure (-0.49 mmHg [-0.66, -0.32]), LDL-C (-2.01 mg/dl [-2.63, -1.40]), HDL-C (1.65 mg/d [1.44, 1.85]), HbA1c (-0.02% [-0.03, -0.01]), and fasting plasma glucose (-0.44 mg/dL [-0.74, -0.15])**;** as well as lower prevalence of metabolic syndrome (OR 0.85 [0.82, 0.88]), CVD (0.92 [0.88, 0.96]), cancer (0.95 [0.91, 0.99]), and lung disease (0.92 [0.88, 0.96]); and higher prevalence of optimal cardiometabolic health, (1.24 [1.16, 1.32]). In prospective analysis, i.FCS was associated with lower all-cause mortality (HR 0.93 [0.89, 0.96]) and a trend toward lower cancer death (0.90 [0.85, 1.00]). Finding were similar in subgroups by age, sex, race/ethnicity, education, and income.

On the basis of demonstrated content, convergent, discriminant and predictive validity, the Food Compass is a powerful tool to guide public health interventions and policies and private sector strategies to identify and encourage healthier foods and beverages.

Keywords: Nutrient profiling systems, validation, product healthfulness, cardiometabolic health

Conflict of Interest Disclosure: Ms. O'Hearn reports research funding from the National Institutes of Health and Vail Innovative Global Research. Dr. Erndt-Marino reports income from Bespoke Analytics, LLC, which received research funding from the Florida Department of Citrus, outside the submitted work. Ms. Gerber reports research funding from the National Institute of Food and Agriculture (USDA) and the National Institutes of Health, and additional income from Inova Medical Systems in the Beatty Liver and Obesity Research Program as well as the USDA-Tufts Human Nutrition Research Center on Aging, all outside the submitted work. Dr. Economos reports research funding from the United States Department of Agriculture National Institutes of Health, JPB Foundation, and Newman's Own Foundation. She also reports her position as Vice Chair to National Academies of Science Roundtable on Obesity Solutions (unpaid) and her Advisory Board position at Care/of Scientific. None of the above relate to the manuscript. Dr. Wong reports research funding from the National Institutes of Health and membership in the US Preventive Services Task Force (unpaid) and National Academies of Sciences, Engineering and Medicine Committee on Evaluating the Process to Develop the Dietary Guidelines for Americans, 2020-2025 (unpaid), outside the submitted work. Dr. Blumberg reports being on the scientific advisory board for Bragg Live Food Products, LLC, California Prune Board, California Walnut Commission, Cranberry Institute, Good Pharma, LLC, Guiding Stars Licensing Co., Inside Tracker/Segeterra Inc., and January.ai, also all outside the submitted work. Dr. Mozaffarian reports research funding from the National Institutes of Health, Gates Foundation, Rockefeller Foundation, and Vail Innovative Global Research; and scientific advisory board for Beren Therapeutics, Brightseed, Calibrate, DayTwo (ended 6/2021), Elysium Health,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Filtricine, Foodome, HumanCo, January Inc., Perfect Day, Season and Tiny Organics, all outside the submitted work.

Further Collaborators: In addition to the listed authors, Naglaa H. El-Abbadi, William A. Masters, Paul Jacques, Peilin Shi, and Renata Micha were co-authors on the original Food Compass publication in Nature Food (Oct 2021): "Food Compass is a nutrient profiling system using expanded characteristics for assessing healthfulness of foods"

SY(T2)3-3

Construction of a database of functional components in foods related to our health

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The future of personalized health care requires food personalization, which in turn requires relevant information about individuals, such as health status, genes, microbiomes, preferences, and allergies. It also requires information about foods, such as nutrients, functional components, traceability, taste, expiration dates, and cooking methods. By integrating these data and performing a detailed analysis, a new, individualized, food-based system for improving people's healthy life expectancy will be established. It is necessary to establish a new health assessment system based on health surveys of healthy people to obtain relevant information on individuals. Although information on nutritional components in foods is well established worldwide, there is little systematic information on functional components. To find food components that contribute to health from observational studies, it is important to construct a database of the nutritional and functional components of each food. Functional components described here are chemical substances in foods that are clearly involved in health, such as polyphenols, carotenoids, sulfur-containing compounds, polysaccharides, and lipids. NARO published evidence of health effects of agricultural products through human intervention studies (RCTs) and systematic reviews, as well as analysis of functional ingredients involved in these effects. The published functional ingredients include approximately 80 components, with data for 180 foods ingredients (https://www.naro.go.jp/laboratory/nfri/contens/ffdb/ffdb.html) It is important to detect and improve the state of minor health complaints, which is a state of slight mental and physical disorder from a healthy state to prevent disease. To identify food components that improve minor health complaints and prevent diseases, and to design optimal diets for individuals, data on such functional components related to health must be collected for each of the foodstuffs that make up the diet. It is necessary to establish rules and standardize the selection of foods to be analyzed and the method of food component analysis, since the food ingredient value of agricultural, forestry, and fishery products vary greatly depending on the variety, production area, cultivation method, and cooking method. Currently, a study to evaluate minor health complaints and explore and analyze food ingredients that promote health is being conducted using a cross-sectional observational study of 1,000 healthy individuals (a cross-ministerial Strategic Innovation Program (SIP) project).

Keywords: Functional component data, minor health complaints

SY(T2)4-2

Understanding eating patterns: the potential of a smartphone food diary application in nutrition research

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Eating patterns is increasingly recognized as an important and complementary concept for formulating dietary guidelines and interventions, however there are still significant gaps in the evidence base. Eating patterns refers to the ways in which foods are consumed together in discrete eating occasions (such as meals and snacks). The eating patterns framework encompasses three domains: (1) patterning of eating occasions (e.g., frequency and timing); (2) content (e.g. food combinations and nutrient content), and (3) context (e.g. eating with others, location of eating and activity whilst eating). Appropriate dietary assessment methodology has been a limiting factor in the development of research examining eating occasions and eating patterns at the population level. While FFQs may have low respondent burden, they do not provide data on how foods are consumed together in meal or snacks. New technology allows real-time data collection in the settings in which food is consumed. The development of electronic food diaries, combining the ability to take photographs, record verbal messages and use reminder prompts, can decrease the participant burden associated with the more detailed measures of food intake required for the investigation of eating patterns and can more easily incorporate measures of eating occasions and provide new research opportunities in this field. We developed a Smartphone food diary using Ecological Momentary Assessment principles to examine food intake at the level of eating occasion and that allowed assessment of the three eating pattern domains. The Smartphone diary allows participants to record food and beverage intake at each eating occasion by providing an image, and/or written message describing food types and the amounts of each food consumed. For each eating occasion, the diary also incorporates questions about the context of the eating occasion such as where they ate, who they ate with, what they were doing when eating (e.g., watching television). The Smartphone diary prompts users if they have not recorded any eating occasions within a 3-hour period during waking hours and at the end of each day, participants will also be prompted to enter any forgotten foods or eating occasions. Using this food diary, we have conducted research examining eating patterns in 700 young adults examining in meal skipping, snacking, temporal eating patterns and determinants of eating patterns. We have

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DOI: 10.1159/000530786

also conducted further work to examine the relationships between eating patterns, physical activity, sleep, and mood combining the Smartphone food diary with other wearable devices. Evidence generated through examining eating patterns opens new opportunities and may have multiple applications. These include the development of new evidence for associations with health outcomes that can be used in interventions for the prevention and management of chronic conditions, new ways to explore nutrition science concepts relating to nutrient interactions within meals and snacks, and new applications to behavior change interventions and other strategies with translation to consumers through targeted and tailored nutrition communication messages.

Keywords: Dietary assessment, Ecological momentary assessment

Conflict of Interest Disclosure: None

SY(T2)4-3

Development of self-administered dietary questionnaires specially designed for measuring meal-specific dietary intakes and eating patterns

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Recent studies have suggested that not only the amount and type of food intake but also the circadian timing of food intake need to be considered, given that food intake, appetite, digestion and metabolism each exhibit circadian patterns. Additionally, understanding food combinations at meals could be useful for the development of public health nutrition policies and recommendations. Unfortunately, research on these topics is constrained by the fact that the primary method of dietary assessment currently employed in most cross-sectional and prospective cohort studies is food frequency questionnaire, which precludes an informed evaluation of the timing of dietary intake and meal-specific dietary intake. This kind of information can be derived from more detailed dietary assessment methods such as dietary record (DR) and 24-h dietary recall. However, when using these methods, collection of dietary data over multiple days is essential for the assessment of habitual intake at the individual level and is still not always feasible because of its expensive and burdensome nature. Taken together, the development of dedicated fit-for-purpose methodology for collecting data on meal patterns and time of day of dietary intake which is also inexpensive to administer and has low participant burden is required to efficiently advance this new research field. Here, the author presents the development of two self-administered dietary questionnaires specially designed for measuring meal-specific dietary intakes and eating patterns. The Food Combination Questionnaire (FCQ) is a 4-page, self-administered questionnaire designed for distinguishing food combinations at each meal type. The basis of the FCQ is a food combination database developed using 16-day DR from 242 Japanese adults. An analysis showed that daily dietary intakes estimated by FCQ were comparable with those estimated by a well-established diet history questionnaire. Using the FCQ, the most common food combinations consisted of rice, vegetables, and noncaloric beverages for all main meals (breakfast, lunch, and dinner) among Japanese adults, while those for snacks consisted of confectioneries and noncaloric beverages. The FCQ may be useful in capturing the complex nature of food combinations. The Meal-based Diet History Questionnaire (MDHQ) is a self-administered questionnaire designed for estimating food and nutrient intakes for each meal type separately. The MDHQ consists of three different parts: consumption frequency of generic food groups for each meal type, relative consumption frequency of sub-food groups within one of the generic food groups, and general eating behaviors. Because the development of MDHQ is based on comprehensive information on actual food consumption (16-day DR from 242 Japanese adults), this innovative tool may be promising for future chrono-nutrition research. A rigorous evaluation of validity of the MDHQ is under preparation.

Keywords: Circadian timing, food combination, meals, snacks, questionnaire

SY(T2)5-2

Overview of Harmonization of a Global Process for Setting Nutrient Reference Values

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Nutrient Reference Values (NRVs) for population groups are required for estimating the proportion of the population that has inadequate or excessive intakes of specific nutrients, based on a comparison of usual intakes to the Average Requirement (AR) and the tolerable Upper Nutrient Level (UL) respectively. NRVs are also used to plan diets for population groups, and to plan gaps that need to be filled by specific foods, or by food fortification or supplementation. There is now general consensus about the model and methods that should be used to set these two values, which have been well-described by the National Academy of Sciences, Engineering and Medicine (NASEM) in the USA and by the European Food Safety Authority (EFSA) in Europe, for example. Countries and regions may decide to use this model when updating their recommendations or creating ARs and ULs for the first time, or to update some of their values based on local conditions, in view of the very expensive process that is needed to review the literature on requirements. In addition to global harmonization of the process for setting NRVs, a set of proposed harmonized NRVs has been published using values from NASEM and EFSA reports plus additional values to increase the number

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of nutrients with an AR or UL where necessary. It is likely that most population groups have similar nutrient requirements after adjustments have been made for bioavailability of iron and zinc from local diets, and possibly for infections, genetics and body size. Efforts are in progress to review and quantify the adjustments needed. Other speakers in this session will address their own experiences with setting and revising NRVs and make recommendations to support a harmonized approach to both setting and modifying existing NRVs. The overall goal is to move the harmonization process forward and enable values to be set and/or modified efficiently, and global comparisons to be made about the adequacy of nutrient intakes and interventions.

Keywords: Nutrient Reference Values, Values, Average Requirement, harmonization

SY(T2)5-3

The Southeast Asia Model for Harmonizing the Process for Setting Nutrient Reference Values

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Over the past decade, several countries in Southeast Asia individually reviewed their nutrient intake recommendations. National committee usually considered different sets of international recommendations such as those from the US-Institute of Medicine (IOM), the United Nations-FAO/WHO, the European Food Safety Authority (EFSA), together with locally available data and the application of nutrient-specific factors that suits country's context. In the case of Thailand, the revision to update the dietary reference intake spanned from 2013 to 2020. During this period, EFSA has published their scientific opinion on dietary reference values for a group of nutrients. In addition, the National Academies of Sciences, Engineering and Medicine (NASEM) launched a Consensus Study Report on Harmonization of Approaches to Nutrient Reference Values (NRVs) in 2018. The Thai Committee and Nutrients Working Groups were able to review these publications, combined with existing relevant local data prior to making their recommendations. The challenges in making decision were related to issues surrounding nutrient bioavailability as well as bioconversion factor for beta-carotene, in addition to gaps of data on up-to-date food composition table to assess nutrient intake and population micronutrient status. Recognizing the diversity of habitual diets, food systems and multiple burden of malnutrition in Southeast Asia, a regional expert panel could be set up to review the NASEM framework for harmonizing process to derive NRVs as well as the recently published harmonized values, in order to propose the suitable approach to accommodate different scenarios in the region. A connection between the regional panel and international expert group for nutrients deemed significant for the region will be helpful to guide the decision. In addition, the panel can be a platform to share data from countries, for example, on national food consumption survey, national health exam survey, food composition database, relevant evidence and local resources, as well as to identify data gaps and priority areas for future research.

Keywords: Southeast Asia, Nutrient Reference Values, Harmonized Process

Conflict of Interest Disclosure: None

SY(T2)5-4

A Path Forward and What's Needed for a Country to Get There

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As stated by the Committee on the Application of Global Harmonization of Methodological Approaches to Nutrient Intake, Recommendation: The need for nutritional benchmarks is critical all over the world. Different countries set their own benchmarks, using their own processes. To a large extent, in LMIC and LIC, these benchmarks are influenced greatly by central bodies like the WHO and FAO, and by the deliberations of the IOM and EFSA. However, there is an understanding that there should be a uniform framework for deriving Nutrient Reference values, and there is already much confusion about this. Many different NRVs are in vogue, both in concept and in name, and a priority should be that the NRVs should be simplified to only the Average Requirement (AR) of nutrient in a healthy group of individuals where the interindividual requirement variability is known, and the Tolerable Upper Limit (TUL) of intake, which defines a safe limit to the intake of the nutrient. Complexities exist, since not all nutrient AR and TUL are known with any certainty. The next key point is deciding on a biological and technical review framework within which these NRVs will be set. If a new value is required, from scratch, a framework is required to help in selecting the appropriate methodological approach – using homeostatic nutrient balances under different doses of nutrient intake, or using factorial inputs, including the bioavailability of the nutrient from habitual diets. The presence of environmental factors, like pollution or parasites, that may inflate nutrient losses and the requirement. This process requires detailed systematic reviews and is a process that cannot be shortened. A more pragmatic route, of either accepting, updating, or adapting existing NRVs is possible, but even here, a clear process is required, particularly if local area evidence is being added into the mix, along with precise documentation. If NRVs are not relevant locally, an expert panel should adapt values to the local context, again, with transparency and documentation. The key, moving forward, is harmonization by agreeing to the requirement framework (which NRV?), and the process by which these are set, with rigour and transparency.

Keywords: Nutrient Requirements, Harmonization

Conflict of Interest Disclosure: None

SY(T2)5-5

Building an international partnership to support global harmonization of nutrient reference values

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Harmonization of **methods** for deriving Nutrient Reference Values (NRV) and the **values** themselves have been a topic of discussion among nutrition scientists. There are several advantages to pursuing global Harmonized Nutrient Reverence values (H-NRV): it provides a common basis for comparisons; it brings transparency in the values developed by different scientific groups and low-income countries can save on limited resources by using the harmonized methodologies to refine their values. Yet, there are barriers to overcome, e.g., regions may be reluctant to accept global harmonized values that do not take their unique situations into consideration, terminologies around nutrient recommendations are confusing and data sharing may lack openness. However, the current global nutrition situation has made the need for H-NRV relevant and urgent: poor diet is now a leading contributor to disease and death globally, while the 2019 EAT-Lancet report shows that the world could save 11 million premature deaths if diets became healthier. Recent global events have given impetus to the harmonization of NRV. The UN Food Systems Summit 2021 resulted in the formation of several coalitions – such as the school meals coalition and the coalition for healthy diets for all. At the Tokyo Nutrition for Growth Summit 2021, a wide range of stakeholders made financial, policy and programmatic commitments to address all forms of malnutrition. While these developments are laudable, an important basis for ensuring healthy diet are an appropriate dietary reference values to provide the common basis for assessing whether populations are meeting their nutrient requirements. The following offer opportunities for building international partnerships to support global H-NRV: i) A NRV harmonization Task force under the auspices of the International Union Nutritional Sciences will provide access to over 80 Adhering Bodies to support and adopt H-NRV; ii) FAO and WHO, as leading global UN normative agencies, can play an important role by hosting an international Expert Group to guide the harmonization process. iii) Global Academies of Sciences can provide the platform for expert consultations to facilitate the harmonization process. iv) Relevant coalitions of the UN Food systems summit will need H-NRV for assessing whether diets and school meals are meeting nutrient requirement, v) The Codex Alimentarius Commission will need H-NRVs in setting its global standards, recommendation, and labeling policies, given its mandate to protect the health of consumers and ensure fair practices in the food trade.

Keywords: Harmonization, Nutrient reference values, partnership

SY(T2)6-1

Role of serine in brain function

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Aside from ATP production, a major function of glycolysis is to provide precursors, such as L-serine, to support macromolecular synthesis. L-serine is a metabolic hub and plays pivotal role in the brain. It is the precursor of D-serine, the principal co-agonist of synaptic N-methyl D-aspartate receptors (NMDARs) required for the induction of long-term synaptic plasticity in the hippocampus. It also contributes to the homeostasis of synapses and of mitochondrial function by providing lipids. We found that the phosphoglycerate dehydrogenase (Phgdh), the first enzyme of the L-serine pathway, is mainly expressed in astrocytes in mouse and human brain and is critically involved in both long-term synaptic plasticity and spatial memory. We then explored the role of serine in pathological conditions leading to cognitive deficits such as Alzheimer's disease (AD). This disease is also characterized by an early decrease of brain glucose metabolism in specific brain regions. These metabolic alterations correlate with disease progression and even predict histopathological diagnosis. Recent observations suggest that changes in aerobic glycolysis prevail in the early phase of AD. We found that 3xTG mice (a genetic model of AD), at early stage of the disease, exhibit decreased L-serine levels in the hippocampus where in vivo glucose metabolism is reduced but not in the frontal cortex that does not display metabolic alteration. Accordingly, acute application of D-serine or L-serine rescues long-term synaptic plasticity and chronic oral L-serine supplementation restores memory deficits in AD mice. Such chronic treatment also restores the atrophy of hippocampal astrocytes in these AD-mice. These results indicate that a metabolic deficit of L-serine synthesis by astrocytes contributes to cognitive deficits in AD.

Keywords: Brain energy metabolism, Glia, Alzheimer's Disease

SY(T2)6-2

Histidine-derived microbial metabolites in diabetes and drug responses

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Increasing evidence indicates that interactions between the gut microbiota, diet, and the host contribute to the development of number of diseases from intestinal diseases, metabolic diseases and even to neurological disorders. Many studies investigating the role of microbiota in different diseases have identified associations between host phenotypes and microbiota

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

composition. However, associations between individual bacterial genus/species and disease can be positive or negative depending on the disease or treatment context, making it difficult to determine whether particular bacteria are beneficial or detrimental. Despite this issue, the gut microbiome has been shown to be functionally similar even in samples from geographically different regions and between human and mice. In addition, accumulating data suggest that the microbiota may affect host phenotypes through the production of metabolites, which would contribute to the development or treatment of diseases. These bioactive microbial metabolites, sensitive fingerprints of microbial function, can act as inter-kingdom signaling messengers via penetration into the liver through the portal vein and into the host blood circulation and multiple tissues. Thus, investigating microbial metabolites that reflect disease-associated changes of microbial function would overcome the limitations of current microbiome research. This seminar will focus on the microbially produced metabolite imidazole propionate and how it potentially contributes to the pathogenesis of type 2 diabetes. In addition, I will also describe our recent work about investigating potential role of microbial metabolites on inter-individual variations in responses to anti-diabetic drug and metabolic surgery.

Keywords: Histidine, Microbial metabolites, Diabetes, Metformin

SY(T2)6-3

Toward social impact outcome beyond scientific glutamate research

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1. Ajinomoto Co., Inc. (Japan)

In 1908, Dr. Kikunae Ikeda of the University of Tokyo discovered a new taste substance, glutamic acid, in kelp soup stock and named its sensation umami. This was also the world's first report showing that an amino acid alone has a physiological function. After that, the sodium salt of glutamic acid (monosodium glutamate, MSG) was successfully commercialized as an affordable seasoning. By making meals more delicious, MSG intended to contribute to the improvement of nutrition. In this symposium, we'd like to present first the scientific process through which "one aspect of the physiological function of amino acids" gained scientific recognition. Followed by mounting evidence that validated umami as an important factor for the health of humans and planetary health, both aligned with the achievement of the UN SDGs. To clarify these issues, we conducted a review based on a comprehensive search of academic publications listed in the Web of Science database over the past 60 years (1940-2020). Around 4,000 papers have been published during this period from over 75 countries and regions. Historically, the academic research on MSG was inspired by the famous letter to the editor from the Chinese American physician Ho Man Kowk (NEJM, 1967), which suggested a link between MSG and the so called "Chinese restaurant syndrome" (CRS). Two studies published in 1969 gave legitimacy to CRS as a plausible malaise tied to MSG as a seasoning. After that, researchers from Japan and the United States took the lead on the elucidation of the umami sensation centered on the taste of glutamate and the investigation of its application in food. Since the beginning of this century, after multiple umami receptors were reported, many studies have been focusing on its digestive and appetite-regulating functions based on the post-ingestive effects of glutamate. Currently, studies are redirected into the use of umami seasonings to make diets healthier. The second half of this talk will focus on the potential that umami has for the improvement of planetary health and the health of humans increasing the healthy life expectancy and two challenges of malnutrition, poor protein intake (undernutrition) and excess salt intake (overnutrition).

Keywords: Umami taste, monosodium glutamate, glutamic acid, nutrition, salt reduction

SY(T2)6-4

The Tryptophan-Kynurenine pathway in the control of energy metabolism

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Physical exercise can play an important role in the prevention and treatment of a variety of diseases that range from diabetes and obesity to depression, neurodegeneration, and cancer. We have previously shown that exercised skeletal muscle can impact the kynurenine pathway of tryptophan degradation (KP) by increasing the conversion of kynurenine to kynurenic acid (KYNA) and protect from stress-induced depression. Tryptophan catabolism through the KP is well appreciated to generate a variety of bioactive metabolites with immunomodulatory, excitotoxic or neuroprotective properties. Reducing kynurenine levels protects the brain from stress-induced neuroinflammation and other changes associated with depression. This pathway is activated in mice and humans by aerobic exercise training and results in elevated circulating KYNA levels. Our findings show that elevated plasma KYNA levels affect peripheral tissues through a skeletal muscle-adipose tissue and immune system crosstalk mechanism. This results in muscle energy efficiency, increased systemic energy expenditure and reduced adiposity due to the activation of thermogenic pathways in the adipose tissue. We continue to investigate the molecular mechanisms that mediate KYNA-induced energy expenditure, in particular as a GPR35 agonist in several target cell types. We will present recent findings that highlight how KYNA/GPR35 can change immune cell recruitment into metabolic tissues, thus affecting whole body energy homeostasis.

Keywords: Skeletal Muscle, Physical Exercise, Metabolism, Tryptophan, Kynurenines

Conflict of Interest Disclosure: Jorge Ruas is a consultant for Bayer AG

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T2)7-1

Non-proteinogenic amino acids in sarcopenia

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Sarcopenia is a progressive and generalized skeletal muscle disorder involving the accelerated loss of muscle mass and function that is associated with physical disability, poor quality of life and death. A series studies conducted in our laboratory demonstrated that senescence-accelerated mouse prone 8 (SAMP8) mice developed symptoms of sarcopenia and insulin resistance at 40-week old. Mitochondrial quality control and autophagy flux aberrations occurred prior to the onset of sarcopenia, which was suggested as the molecular target to prevent and/or treat the sarcopenia. By using this model, we found phytochemicals, including Lychee-derived low-molecular-weight polyphenol (LLP) and EGCG, alleviated sarcopenia. Recently, non-proteinogenic amino acids (NPAAs) have been shown to regulate skeletal muscle function. Taurine is a NPAA and expressed in high concentration in several mammalian tissues and particularly in skeletal muscle. We found that taurine increased myotube length and area by suppressing atrogenes via inhibiting AKT-NFκB-mediated muscle protein degradation in late passage (aged) C2C12 myotube. Taurine also increased the mitochondrial biogenesis and fusion, decreased damaged mitochondria in late passage C2C12 myotube. Low levels of branched-chain amino acids (BCAAs) are reported to be associated with low muscle mass, poor muscle function, and low muscle strength in community-dwelling elderly. We found levels of BCAAs in muscle appeared to be decreased, but significantly increased in serum of aged mice. We also found that down regulations of BCAAs transporter (LAT1) and metabolic enzymes (BCAT2 and BCKDH) were observed in aging mice. Dysregulated BCAAs metabolism in muscle and elevated circulating BCAAs were correlated with muscle atrophy and insulin resistance via PI3K-AKT-mTOR signaling pathway. In our Lab, LLP was found to contribute to positive protein turnover and shunt circulating BCAA to skeletal muscle, leading to the improvement of BCAA metabolism by increasing metabolic enzymes in skeletal muscle of aged mice (40- wk.- old. SAMP8). In conclusion, NPAAs, such as taurine, act as signaling molecules to modulate pathways involved in the maintenance of muscle quality in sarcopenia. Polyphenols such as LLP, may improve the metabolism/utilization of NPAAs in aging muscle. NPAAs and polyphenols are suggested as nutritional treatments beyond the protein for sarcopenia.

Keywords: Sarcopenia, NPAAs, taurine, BCAA, Lychee-derived low-molecular-weight polyphenol, EGCG

SY(T2)7-2

Regulation of gene expression and cell function by taurine

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Taurine (2-aminoethanesulfonic acid) is one of the major free sulfur-containing β-amino acid found at high concentrations in mammalian tissues. Taurine has been understood to play important roles in various biological processes, including anti-oxidation, membrane stabilization, detoxification, osmoregulation, and bile acid conjugation[1,2)]. We have previously examined the relationship between taurine and its intestinal absorption via taurine transporter (TAUT; SLC6A6) and the function of intestinal epithelial cells. Additionally, we have reported that TAUT activity is regulated by various factors such as extracellular taurine concentration[3)], hyperosmolarity[4,5)], inflammatory cytokines including TNF-α[6)], and lysophosphatidylcholine which is one of the inhibitory components in sesame extracts[7)]. We also found that taurine suppressed cell damage of intestinal epithelial cells by activated macrophage-like cells in an *in vitro* intestinal inflammation model[8)] and also an *in vivo* dextran sulfate sodium (DSS)-induced colitis model[9)]. This suggested that taurine has anti-inflammatory effects in the intestine. However, its regulatory mechanism by which taurine affects the intestinal immune system and suppresses the intestinal inflammatory response is unknown. In addition to this anti-inflammatory effect, several physiological functions of taurine that have been reported[1,2)] are phenomenological and the detailed regulatory mechanisms underlying taurine function, especially at the genetic and molecular levels, remain unclear. Based on this background, we examined the effect of taurine on the gene expression profile of human intestinal-like Caco-2 cells using DNA microarray and found that taurine markedly increased the mRNA expression of thioredoxin interacting protein (TXNIP)[10)]. Further, it was also revealed that taurine regulates cell functions such as adenosine monophosphate kinase (AMPK) phosphorylation *via* TXNIP induction[11)]. The effect of taurine on gene expression in hepatic- and macrophage-like cell line[12)] is also introduced in this symposium.

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Keywords: Taurine, TXNIP, Caco-2, DNA microarray

SY(T2)7-3

L-Citrulline promotes the neurovascular unit function and brain health

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L-citrulline (L-Cit) is a neutral amino acid and a major precursor of L-arginine (L-Arg) in the nitric oxide (NO) cycle. We reported that oral L-Cit administration prevents the cerebrovascular injury following cerebral ischemia in 20-min bilateral common carotid artery occlusion (BCCAO) model mice. After BCCAO ischemia, mice were treated with L-Cit (50, 75, or 100 mg/kg p.o.) for 10 days once a day. L-Cit administration not only prevented the neuronal cell death but also prevented the capillary loss in the hippocampal region following brain ischemia. The cerebrovascular protective effect of L-Cit was associated with the restoration of endothelial nitric oxide synthase (eNOS) expression in the hippocampus. Indeed, the decreased L-Arg-induced NO production was restored in the hippocampus of BCCAO mice following L-Cit administration. Moreover, combined L-Cit and glutathione (GSH) administration also significantly rescued the reduced eNOS protein levels. Finally, the memory deficits following brain ischemia were improved by oral administration of L-Cit or L-Cit/GSH combination. In summary, L-Cit or L-Cit/GSH combination is the potential therapeutic agents that protect cerebrovascular injury and in turn prevent neuronal cell death. Taken together, natural L-Cit administration improves cognitive deficits by neurovascular protection following stroke and aging. The works were in part supported by KYOWA HAKKO BIO CO., LTD.

Keywords: L-citrulline, ageing, neuroprotection, nitric oxide synthase, neurovascular units

Conflict of Interest Disclosure: no COI

SY(T2)8-1

myCircadianClock – a smartphone app to monitor and optimize daily eating patterns

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The quality and quantity of nutrition impact health. However, chrononutrition, the timing and variation of food intake in relation to the daily sleep-wake cycle are also important contributors to health. This has necessitated an urgent need to measure, analyze, and optimize eating patterns to improve health and manage disease. While written food journals, questionnaires, and 24-hour dietary recalls are acceptable methods to assess the quantity and quality of energy consumption, they are insufficient to capture the timing and day-to-day variation of energy intake. Smartphone applications are novel methods for information-dense real-time food and beverage tracking. However, the commercial nutrient apps often ignore eating patterns, and the raw real-time data is not available to researchers for monitoring and intervening in eating patterns. Our lab developed a smartphone app called myCircadianClock (mCC) and associated software to enable long-term real-time logging that captures temporal components of eating patterns, self reported sleep and aspects of physical activity. The mCC app runs on iOS and android operating systems and can be used to track multiple cohorts in parallel studies. The logging burden is decreased by using a timestamped photo and annotation of the food/beverage being logged. Capturing temporal data of consumption in free-living individuals over weeks/months has provided new insights into diverse eating patterns in the real world. This presentation will discuss the myCircadianClock app, and offer examples of ongoing and completed studies on eating patterns and the scope for optimizing eating patterns for health benefits.

Keywords: Circadian Rhythm, Chrononutrition, Time-restricted eating, Intermittent fasting

Conflict of Interest Disclosure: SP is the author of the books "The Circadian Code" and "The Circadian Diabetes Code".

SY(T2)8-2

Assessment of total energy expenditure and physical activity using activity monitors

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To assess total daily energy expenditure (TDEE) under daily living conditions, the doubly labelled water (DLW) technique is considered the gold standard. This technique is accurate but also costly and requires specific lab equipment and expertise. It also provides an average measure of TDEE over a period of one to two weeks and hence no information on physical activity (PA) patterns is available. To overcome these shortcomings, activity monitors can be used to assess activity patterns and an estimate of TDEE can be made, provided the activity monitor has been previously validated in daily life using DLW. Most activity monitors contain accelerometers, that measure the acceleration of the body and hence represent body movement. By definition, body movement leads to energy expenditure (EE) and hence the two always need to be related. That has led to a vast amount of research and the development of activity monitors that also provide an estimate of EE. Validation is essential to know what the contribution of the sensor output is to the prediction of EE. Subject characteristics such as body mass, height, gender and age already explain most of the variation of TDEE, the accelerometer should then represent the physical activity component of TDEE and improve the explained variation. In addition to accelerometers, many activity monitors contain

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

additional sensors measuring other (physiological) output parameters such as heart rate, skin temperature, galvanic skin response (which may represent changes in sweat rate) or gps positioning. Although promising, so far there is no compelling evidence that these additional sensors improve the prediction of EE, so careful consideration is needed whether or not these are worth the extra cost, the extra battery power and storage capacity needed. Again, it is important to know the individual contribution of each outcome parameter to the prediction of TDEE. Another promising development is activity recognition, that goes beyond assessing total PA and activity patterns in terms of time spent in light, moderate or high intensity PA. Using activity recognition, more context can be given to daily activity by assessing for example lying, sitting, standing walking, cycling and others. Given that the relation between accelerometer output and EE is dependent on the activity performed, this development may eventually also lead to better prediction of TDEE. In conclusion, activity monitors have been proven to be extremely valuable in objectively measuring PA. In addition, when an activity monitor has been shown to be sufficiently valid, fairly accurate estimates of TDEE can be made. With that, they are valuable tools not only in PA research but also in nutritional research when energy balance is studied.

Keywords: Energy expenditure, accelerometer, doubly labelled water, wearable sensors, energy balance

Conflict of Interest Disclosure: None

SY(T2)8-3

Dietary improvement using a self-monitoring device for urinary sodium-to-potassium ratio

Atsushi Hozawa[1], Mana Kogure[1]

1. Tohoku University (Japan)

Recently, the sodium (Na)/potassium (K) ratio was reported to be associated with blood pressure (BP). Furthermore, a Na/K ratio self-monitoring device using spot urine was established recently. We are performing several studies using the device. The first, we incorporate this device to community based cohort study. We asked participants to measure urinary Na/K ratio for 10 days, and around 10,000 participants measured their Na/K ratio. The temporary analyses clearly showed that multiple measurements of the urinary Na/K ratio are strongly related to home hypertension compared with single measurement. The second, we incorporate this device to health check-up in community for several years. As a cross sectional analyses, we observed positive relationship between single measurement of Na/K ratio and blood pressure measured at screening settings. We also observed districts which showed higher Na/K ratio showed higher blood pressure level. Furthermore, as a result of follow-up measurement, both blood pressure level and Na/K ratio were declined in this measured area, and the change in systolic BP and diastolic BP was positively associated with the change in urinary Na/K ratio. The association of the change in urinary Na/K ratio with hypertension and changes in systolic and diastolic BP can be explained by a change in alcohol intake, BMI, and urinary Na/K ratio. Therefore, measuring the urinary Na/K ratio in community settings is a potential population approach for counteracting hypertension. Now we asked several communities or work sites to incorporate the device to screening settings. Our finding suggests that measuring Na/K ratio may change the consciousness for salt intake and potassium intake. This change might yield better effect on blood pressure level in communities.

Keywords: Sodium, Potassium, Population approach, Health Check-up

Conflict of Interest Disclosure: Omron Healthcare

Further Collaborators: Tohoku University Center of Innovation

SY(T2)8-4

Prevention of Worsening Diabetes through Behavioral Changes by an IoT-based Self-Monitoring System in Japan (PRISM-J)

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1. National Center for Global Health and Medicine (Japan)

The use of the Internet-of-Things has improved glycemic control in individuals with diabetes in several small-scale studies with a short follow-up period. This large-scale randomized controlled trial investigates whether a smartphone-based self-management support system prevents the worsening of glycemic control in individuals with type 2 diabetes. Individuals with type 2 diabetes (age range 20–74 years; n=1,159) were recruited, enrolled, and randomly assigned to two groups: the intensive therapy group and the conventional therapy group. Participants in the intensive therapy group were supervised to use an automated Internet-of-Things system that demonstrates a summary of lifelogging data (e.g., weight, blood pressure, and daily activities) obtained from each measurement device and received feedback messages via smartphone applications to encourage them to increase their physical activity and to monitor weight and blood pressure. Participants in the conventional therapy group were allowed to use the same measurement devices as part of the routine diabetes care but without the Internet-of-Things system. The primary endpoint is the between-group difference in HbA1c levels from baseline to 52 weeks. This randomized controlled study will test the hypothesis that an Internet-of-Things-based self-monitoring system could effectively prevent the worsening of diabetes in individuals with type 2 diabetes. The expected results of the study should facilitate the development of novel strategies for both diabetes treatment and social health.

Keywords: Diabetes, Internet of things, Behavioral change, Glycemic control

SY(T2)9-1

Challenges for nutritional epidemiological research in the consortium of prospective cohort studies in Asian countries

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Nutrition epidemiology studies have been conducted in many prospective cohorts around the world. Each cohort incorporates its dietary assessment methods into the investigations. Among dietary assessment methods, the food frequency questionnaire (FFQ), developed based on validation studies conducted by each cohort, is often used. Problems arise when attempting to integrate cohort data nutritional epidemiologically, because the food items in FFQs are selected according to the situation in each country (e.g., food items commonly eaten or the food culture) and the same food items do not always have the same nutrient composition.

The presenter has conducted two research projects in the Asian Cohort Consortium (ACC), an integrative cohort consortium involving around 40 prospective cohorts in Asia. Two pooled analyses regarding the association between reproductive factors and endometrial cancer and coffee intake and endometrial cancer were conducted. In these two projects, 12 or 13 cohort studies in Asia (Including Japan, Korea, Singapore, China, etc) were combined. In the ACC, data provided by each cohort is compiled in the data center in the ACC management team, and each researcher examines analysis methods for integration or discusses the method for integration in the working group (WG) for the exposure. In the case of endometrial cancer, most cohorts that participated in this pooled analysis included less than 100 cases and researchers could not conduct meta-analysis after the calculation of beta estimates in each cohort. It was necessary to attempt a pooled analysis (aggregated analysis) due to the small number of cases of the outcomes. For this reason, the WG examined the questionnaires of each cohort to determine whether the exposures can be integrated and created an analysis program within the WG for integration in the case of reproductive factors.

In this session, an example of integration of prospective cohort studies will be presented, comparing studies of dietary and non-dietary exposures, including some of the difficulties related to the integration of nutritional-epidemiological exposures.

Keywords: Prospective cohort study, Pooled analysis, Nutritional epidemiology, Cohort consortium

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T2)9-2

Opportunities and challenges of international collaborative pooled analysis of dietary cohort studies

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International collaborative work of prospective cohort studies has been implemented for a few decades. It has provided a rich source for the world's researchers to investigate the role of dietary factors in the development of many diseases. A pooled analysis of the existing cohort studies has strengths, including increased statistical power, disclosure of unpublished work, use of the standardized approaches, significant contrast of dietary exposures, the inclusion of diverse populations, and built-up of partnerships of investigators. The advantages of pooled analyses in nutritional epidemiology are significant, and an increase in statistical power and analysis of multi-level exposures in the consortium data allow us to have better insight and knowledge of dietary factors related to chronic diseases. However, facilitating data harmonization of foods, food groups, and nutrients in the consortium data remains challenging. Combining and standardizing dietary data is far more complex than anthropometric or pharmaceutical data, given differences in food frequency questionnaires, foods assessed, dietary assessment's validity, and nutrient databases' availability across individual studies. The Asia Cohort Consortium is an international collaboration that aims to understand the etiology of common and rare diseases by combining data from multiple Asian prospective cohort studies. Opportunities and challenges of international collaborative pooled analysis of dietary cohort studies will be presented based on the experiences of the Pooling Project of Prospective Studies of Diet and Cancer and the Asia Cohort Consortium.

Keywords: Pooled analysis, Nutritional Epidemiology, Asia Cohort Consortium

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T2)9-3

Methods for pooling epidemiologic studies: the Pooling Project of Prospective Studies of Diet and Cancer

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1. Harvard T.H. Chan School of Public Health (USA), 2. Harvard Medical School (USA), 3. Columbia University Irving Medical Center (USA), 4. International Agency for Research on Cancer (France)

The Pooling Project of Prospective Studies of Diet and Cancer [DCPP] is an international consortium of cohort studies that was established in 1991. To maximize the quality and comparability of the studies in the consortium, the following criteria are used for inclusion in the consortium: (a) prospective design; (b) use of a validated long-term, comprehensive dietary assessment method sufficient to calculate total energy intake; and (c) at least one publication on any diet and cancer association. For each outcome evaluated, a minimum number of cases in women and in men is also specified for a study to be included in analyses of that outcome. Additional inclusion criteria may be identified for each project. For a recent project to examine associations with alcohol use and multiple cancers, the consortium was expanded to include cohort studies that had detailed data on alcohol use but did not administer a comprehensive dietary assessment method. Currently, the consortium includes 36 cohort studies located in North America, Europe, Asia, and Australia; 32 of which meet the dietary inclusion criteria.

The consortium uses an opt in model in which cohorts indicate whether they are interested in participating in each project. Participating cohorts send their primary participant-level data (without personal identifiers) to the coordinating center which has the primary responsibility for checking and harmonizing the data from each cohort and maintaining the centralized data repository. To date, data collected at study enrollment on dietary, anthropometric, reproductive, and other lifestyle factors and medical histories, as well as cancer and mortality outcomes, have been harmonized. Authorized researchers access the data through a secure password-protected server. The data repository has been expanded over time to accommodate new projects evaluating new exposures and/or new outcomes. To date, projects have examined/are examining bladder, breast, colorectal, kidney, lung, ovarian, pancreatic, prostate, stomach, thyroid, and upper aerodigestive tract cancer, non-Hodgkin lymphoma, amyotrophic lateral sclerosis, and coronary heart disease.

We primarily use a two-stage analytic approach in which study-specific risk estimates are calculated and then pooled using random effects models. Analyses have also been conducted in which the data from the participating cohorts are combined into a single data set prior to analysis. In those analyses, the models are stratified by study. Analyzing the harmonized participant-level data in each cohort reduces potential sources of heterogeneity across the studies; allows flexibility in the modeling of the exposures; enables investigation of population subgroups and tumor subtypes; permits evaluation of whether participant- and study-level characteristics modify the exposure-disease association being evaluated; and facilitates examination of rare exposures and rare outcomes that individual studies may not have sufficient power to evaluate. As a result, comprehensive analyses of numerous exposure-disease associations can be conducted to generate key evidence on those associations.

Keywords: Consortium, pooled analyses, methods, nutrition, cancer

SY(T2)10-1

A brief overview of EPIC: its rationale, dietary assessment methodology and key achievements

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The European Prospective Investigation into Cancer and Nutrition (EPIC Study) is one of the largest prospective cohort studies in the world, with more than half a million (about 520 000) participants enrolled from 23 study centers in 10 European countries: Greece, Spain, Italy, France, Germany, Netherlands, United Kingdom, Denmark, Sweden, and Norway. The EPIC Study was designed to investigate the relationships between diet, nutritional status, lifestyle and environmental factors, and the incidence of cancer and other chronic diseases. Due to the geographical spread of the countries, from northern to southern Europe, variation in dietary intake was large, which makes it possible to study the impact of diet across a wide range of intakes. This is important, because within a country dietary habit can be relatively homogenous, which makes it difficult to study associations. For dietary assessment, information on usual diet was collected by country-specific dietary assessment questionnaires at enrollment in 1992-2000. To this end, questions were included on consumption of the foods that contributed most to dietary intake in the specific countries. Questions on both frequency of consumption, as well as on portion size were included and for a number of foods photographs of different portion sizes on a plate were added, to improve estimation of the portion size. To calibrate dietary measures, a standardized, computer-assisted 24-hour dietary recall was also conducted at each study center on stratified random samples of the participants (about 37 000 individuals). To improve comparability of nutrient databases across 10 European countries, a harmonized nutrient database was developed, containing 26 major nutrients and their related components between 550 and 1500 foods per countries (about 10 000 foods in total). A biobank has been established, storing different blood fractions at -196 degrees Celsius. EPIC represents the largest single resource available today world-wide for prospective investigations on the etiology of cancers and other disease that can integrate questionnaire data on lifestyle and

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

diet, biomarkers of diet and of endogenous metabolism and genetic polymorphisms, and so far, more than 1600 scientific articles have been published based on EPIC. In this presentation the methodology of EPIC will be discussed, as well as challenges in nutritional research and some important contributions of the EPIC Study to the scientific literature will be presented.

Keywords: Dietary assessment, Longitudinal cohort study, Methodology, European multi-country study, Diet and disease

Conflict of Interest Disclosure: None

Further Collaborators: I acknowledge the large group of EPIC collaborators; I will name and specifically acknowledge the most important ones in the presentation.

SY(T2)10-2

How different are dietary habits and eating patterns between East Asian and European countries? Findings from Japan

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Mainly because of their possible contribution to long life expectancy, much attention has focused on the characteristics of Japanese dietary habits. Here, the author describes a number of studies on dietary habits and eating patterns in Japanese, in comparison with findings from the European Prospective Investigation into Cancer and Nutrition (EPIC) study. Eating frequency has been the most widely investigated variable of eating behaviors in adults. In EPIC study, mean total eating frequency varied across countries (4.9 to 7.0 times/d), with a trend for lower eating frequency in Mediterranean countries (Greece, Spain, Italy, and France) compared with central European (Germany, the Netherlands, and UK) and Nordic (Denmark, Sweden, and Norway) countries. In contrast, mean total eating frequency in 2681 Japanese adults (4.7 times/d) was consistently lower than that observed in European countries. This appears to be mainly due to a low snack frequency in Japanese (mean 1.7 times/d) compared with snack frequency in Europe (mean 2.1 to 4.2 times/d). Further, it appears that meal skipping is rare in Japan. On the basis of 8-day dietary record data collected by 2681 Japanese adults, 86%, 91%, and 96% of adults reported consumption of breakfast, lunch, and dinner, respectively, over all eight days. Although the direct comparison is difficult due to difference in dietary assessment method, the proportion of consumers on a diet recall day ranged from 86.0 % to 99.8 % for breakfast, from 72.4 % to 100% for lunch and from 89.2 % to 100% for dinner in 10 European countries in EPIC study. The Japanese diet is also characterized by three large meals with small snacks. An analysis based on the National Health and Nutrition Survey showed that the proportion of daily energy intake consumed at breakfast, lunch, dinner, and snacks was, on average, 23%, 30%, 40%, and 8%, respectively, in Japan. In contrast, in 10 countries in EPIC study, the proportion of daily energy intake consumed at breakfast, lunch, dinner, and snacks ranged from 9% to 9% to 20% (median 16%), from 16% to 45% (median 26%), from 24% to 40% (median 32%), and from 10% to 35% (26%), respectively. However, studies have consistently shown that Japanese diets are high in dietary glycemic index (GI) compared with Western countries. According to an analysis based on the National Health and Nutrition Survey, mean dietary GI was 65.9 for men and 63.9 for women (GI of glucose = 100). In contrast, in EPIC study, overall mean GI was 56.8 for men and 55.3 for women. This is highly likely due to differences in the major food contributors to dietary GI. In Western diets, these are based on a variety of foods, including bread, pasta, potatoes, sweetened beverages, sugar, fruit, and breakfast cereals. In contrast, the major contributor in Japanese diets is white rice, a major staple food with a high GI (i.e., 76). These large differences in dietary habits warrant thorough investigation on the association between dietary factors and chronic diseases within a specific population.

Keywords: EPIC, Europe, Japan, diet, epidemiology

Further Collaborators: Dr. Kentaro Murakami is an Assistant Professor in the Department of Social and Preventive Epidemiology, School of Public Health, University of Tokyo. He is a nutritional epidemiologist whose research interests include validation of dietary assessment methods, assessment of dietary patterns, eating behaviors, and dietary quality, and identification of determinants of healthy and unhealthy eating behaviors.

After graduating from Hokkaido University (Faculty of Education), Dr. Murakami received his M.S. and Ph.D. degrees in Food Science and Nutritional Science from the University of Shizuoka, Japan. After post-doctoral training at the University of Ulster in Northern Ireland, he moved to Tokyo in 2016. He has published over 150 research papers and serves on the editorial board of several scientific journals, including as a Deputy Editor of the British Journal of Nutrition.

SY(T2)10-3

What we can learn from EPIC: a vision for East-Asia collaboration from the European experience

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EPIC used the most advanced assessment tool at that time, a validated self-administered food frequency questionnaire (FFQ) for optical scanning tailored to the local population. This strategy had the advantage that local FFQs were available at the beginning of the recruitment but the disadvantage that not all of the FFQs covered the agreed nutrients and food groups well, as shown in the validation studies. Thus, it was concluded that this diversity of the local country-specific FFQs might limit EPIC-wide diet-health analyses due to differences in assessment quality. Subsequently, a calibration tool was introduced in a small subgroup (N=36,000) comprising of one 24h-recall per subject. Unfortunately, the decision to obtain one 24h-recall per subject limited the calibration approach to the local mean reflected by

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

the reference mean but did not allow to reconstruct the variation within the local population. The so-called linear calibration approach calculated the variation within the center population measurable by the local FFQ. Nevertheless, in many of the publications about diet-health relationships calibrated and uncalibrated results were shown. In my memory, this publication strategy often resulted into confusion for the readers. In the subsequent time periods, statistical groups including EPIC developed models that identified the error structure of the main assessment instrument (FFQ) in a study compared to the reference instrument (food records and 24h-recalls) and recovery biomarkers, collected in small subgroups. Hardly, the parameters obtained in such models were used to correct the initially found diet-health relationships based on the FFQ. A clear learning experience from EPIC could be seen in the fact that all the assessment instruments and their analytical strategies should be agreed in advance and that they should be available from the beginning of a collaboration. Any ex-post standardization at later stages requires optimal conditions which will often not exist. It should be aim that the assessment instruments show high external and internal quantitative validity. The most recent insights into proper dietary assessment favour a combination of short-term (24-h-recalls) and long-term assessment instruments (FFQs) coupled with a modelling strategy of the individual diet. The 24h-recall is now available as self-administered program (p.e. ASA24 for the US amd MyFood for Europe) that show high external validity compared to survey data. Such programs allow to collect a number of 24h-recalls per subject across seasons without a high load for the organizers of the study. In addition, common FFQs across different eating cultures using the same food coding as the 24h-recall will limit differences due to different FFQ instruments. Hybrid solutions are also possible as developed for the German Health study. The ability of the 24h-recall to record time and meal context of food consumption offers the possibility to include timing of food consumption into the risk analyses leading to a more extended understanding of eating. Our group could among others already show that timing of food intake matters in terms of metabolic effects.

Keywords: Dietary assessment, modelling, EPIC, collaboration

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T2)10-4

Potential barriers and opportunities for the development of cross-country nutritional epidemiologic research in East Asia: Experience in Singapore

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Cross-country nutritional epidemiological research brings about multiple benefits, from encouraging multi-level analyses that explore local, national and global influences on diet to offering the opportunity for conceptual and methodological development through the exchange of ideas and experiences between diverse research teams. Moreover, the population context of individual characteristics has shown to be a stronger determinant of disease at population level than individual level risk factors. However, the increased logistical complexity and costs involved, the methodological and analytical challenges and trade-offs are important issues to consider before embarking on cross-country comparative work. In particular, comparisons across heterogenous populations such as multi-ethnic populations have their own set of challenges. Based on data and my experience from a few cross-country research studies in the area of maternal and child nutrition, these considerations and lessons learnt will be shared and illustrated.

Keywords: Cross-country, Nutrition Epidemiology, East Asia, Singapore

Conflict of Interest Disclosure: Nil

SY(T2)11-1

WHO project: Use and interpretation of haemoglobin concentrations for assessing anaemia status in individuals and populations

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Controlling the global burden of anaemia is an important public health priority: the 2025 Global Nutrition Targets pursue a 50% reduction in the prevalence of anaemia in women of reproductive age, while the 2030 Sustainable Development Goals 2 and 3 describe alleviation of anaemia. Trends in the prevalence of anaemia for the years 2000 to 2019 indicate a slower decline in anaemia prevalence since 2010, as compared to the period 2000 to 2010, with 30% (571 million) of women 15-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

49 years of age and 37% (32 million) of pregnant women estimated to be affected by anaemia globally in 2019. The World Health Organization has initiated a project to review global guidelines on haemoglobin cutoffs to define anaemia. Appropriate guidelines for measurement of haemoglobin and definition of anaemia are crucial for both clinical and public health medicine but require consideration of the range of complexities across different populations. Decisions to implement and monitor programmes that integrate nutrition specific and nutrition-sensitive interventions are predicated on the prevalence of anaemia as well as monitoring differences across groups in terms of accessibility, availability, acceptability and the quality of the interventions. Based on priority questions and research needs posed by experts after a public call and in review of the priorities outlined in the 2030 Sustainable Development Goals, the WHO Department of Nutrition and Food Safety convened a technical meeting on the use and interpretation of haemoglobin concentrations for assessing anaemia status in individuals and populations. The outcomes of this meeting served as the foundation for developing a scoping document for producing the key questions to be addressed in the revised guidelines. The first guideline development group meeting was held in November 2019 where the final key questions were agreed. One of the key questions related to the review of evidence on the need for adjustments in haemoglobin concentrations to account for differences in settings and populations. Several technical meetings have been developed to cover various aspects highlighted during the guideline development meeting, including the variations in haemoglobin concentrations during the lifecycle as well as the need for adjustments by elevation above sea level of the place of residence/work, smoking, genetic background, indoor cooking, outdoor pollution and malaria endemicity. Other critical aspects for discussion included the role of infection, inflammation and genetic ancestry as potential determinants for adjustments of haemoglobin concentrations to define anaemia, especially at population level, and also considerations about blood sampling and analytical methods used for haemoglobin determinations. The main focus of discussions on all those technical meetings was identifying the need and magnitude of adjustments required to account for the effect of all the above-mentioned determinants in different settings and populations with explicit consideration of age and sex. All the findings and conclusions from technical meetings will be presented to the guideline development group for reviewing, discussing, and preparing recommendations for the new guideline on the revised cutoffs to define anaemia in individuals and populations.

Keywords: Anaemia, Haemoglobin, Cutoffs, Prevalence, Public health

Conflict of Interest Disclosure: None

Further Collaborators: Maria Elena Jefferds, Sant-Rayn Pasricha, Lisa Rogers, Andrea Sharma

SY(T2)11-2

Variability in haemoglobin concentration by blood source and analytical devices

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Background: The accurate and reliable measurement of haemoglobin (Hb) concentrations to identify anaemia in individuals and populations is a global priority. The cyanmethemoglobin method to analyze venous blood is the standard to assess Hb concentrations, however, various blood sources and analytical devices are used in both uncontrolled field settings and controlled clinical settings that may result in systematic or random bias. Single drop capillary blood is often the preferred blood source and most feasible in low resource settings, for screening blood donors or for entry into public health programs, and in large population-based surveys. Non-invasive and invasive point of care devices are often the preferred analytical devices for those settings and purposes. Automated hematology analyzers are typically used in clinical laboratory settings. This presentation will describe select evidence reviewed at WHO technical consultations and WHO Guideline Development Group meetings on the methods to assess Hb concentration for identifying anaemia in individuals and populations with a focus on variation and error by blood source (capillary vs venous) and invasive analytical devices (HemoCue models vs automated hematology analyzers).

Methods: WHO commissioned papers including systematic reviews and case studies to summarize technical areas and identify evidence gaps to provide stakeholders with state-of-the-art information, research needs and guidance on assessment of Hb concentrations in individuals and populations. The Hb assessment papers summarized the range of methodologies used to measure Hb concentrations in i) clinical laboratories, and ii) field studies, the principles of each assay, the benefits and limitations of each method, those currently considered best practice for use in clinical and field studies, and quality control aspects of laboratory and field measurements. In addition, after the call for authors closed and a journal supplement of the commissioned articles was published, newly published manuscripts and relevant manuscripts under preparation were also shared with meeting participants or their conclusions summarized and presented at the WHO meetings.

Results: Literature shows that single drop capillary blood compared to venous blood results in systematic bias in Hb measurement that may introduce small variation, but it was agreed during the meetings that correction is not feasible. For various reasons, such as human error or individual variation, single drop capillary blood compared to venous blood may also result in poor precision that causes random error and wide variation, and it was concluded this cannot be corrected. For example, in a 2016 Demographic and Health Survey (DHS) in Malawi that collected single drop capillary blood to assess anaemia, as is typically done in the main DHS survey, but also included a national micronutrient survey component that assessed anaemia using venous blood, there was a difference in anaemia prevalence of 31% in children and 9% in non-pregnant

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

women. Comparing HemoCue models to automated hematology analyzers found HemoCue models generally performed adequately, and any variation could be addressed with quality assurance activities. Training is required for high quality blood extraction and use of analyzers.

Conclusions: Venous blood is the preferred blood source, when possible, and training is critical for high quality Hb assessment.

Keywords: Haemoglobin, anaemia, venous, capillary, diagnosis

SY(T2)11-3

Hemoglobin corrections for elevation and smoking

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Background: Interpretation of hemoglobin (Hb) to identify anemia requires correcting for elevation and smoking, hypoxia-inducing factors that raise Hb concentration. Current WHO recommendations to correct Hb were derived from data collected before 1985, from low-income preschool-aged children in the United States and indigenous men in Peru for elevation, and from white women-of-reproductive-age in the United States for smoking. Given age of the data and limited representativeness of these data, we reexamined associations between Hb and elevation or smoking using population-based data collected after year 2000. This presentation provides an overview and summary of analyses examining infants (INF; < 6 months), preschool-aged children (PSC; 6-59 months), school-aged children (SAC; 5-14 years), men and non-pregnant women-of-reproductive-age (M, WRA; 15-49 years), and older men and women (OM, OW; 50-80 years).

Methods: Analyses pooled data from population-based surveys or health center data that included data on hemoglobin and elevation and/or smoking from the following countries (years): Afghanistan (2014), Azerbaijan (2013), Bolivia (2013-2015), Colombia (2010), Ecuador (2012), Georgia (2009), Guatemala (2013, 2015-2019), Laos (2006), Malawi (2016), Mexico (2006, 2012), Nepal (2016), Papua New Guinea (2005), Peru (2015-2019), United Kingdom (2008-2014), and United States (2003-2006, 2015-2018). While not all countries contributed data to each population group, in total there were 3,450,834 and 27,911 observations examining elevation and smoking, respectively. Elevation data ranged from -28 to 5,012 meters (m). Smoking was examined as smoker/nonsmoker and by cigarette quantity per day. Generalized linear models were used to assess Hb associations with elevation and/or smoking by population group. Where data was available, robustness of associations was examined controlling for known causes of anemia [inflammation-corrected iron (ID) and vitamin A deficiency (VAD)] or restricting to healthier populations [no ID and no VAD]. Models were used to propose corrections to Hb for elevation and smoking and compared to WHO recommendations.

Results: Models confirm Hb is positively associated with both elevation and smoking and associations were robust to model specification. Elevation corrections were similar (differences <5 g/L at any elevation) across population groups (INF, PSC, SAC, WRA) at elevations <3500 m. Data were sparse above 3000 m but corrections began to diverge by region (e.g., Nepal vs Ecuador, Bolivia, Peru). Only WRA had both elevation and smoking data; these models confirm elevation and smoking corrections are additive. Data among heavy smokers (>20 cigarettes/day) were sparse. Corrections for any smoking and by quantity differed between men and women by ≦3 g/L. Proposed corrections using contemporary, multinational data suggest current recommendations under-correct Hb for light smokers (<10 cigarettes/day) and for residence at lower elevations (500-2000 m) and over-correct Hb at higher elevations (>3000 m).

Conclusions: Hb corrections for elevation and smoking likely need updating. It is possible that one set of corrections for elevation can be applied to all age groups living <2500m where 95% of the world population reside. However, epigenetic adaptions to elevation exist for populations residing at higher elevations; elevation corrections for these populations may need to differ by region. Findings will inform global guidelines on anemia assessment.

Keywords: Anemia, Hemoglobin, Elevation, Smoking, Assessment

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T2)11-4

Additional factors influencing haemoglobin thresholds to define anaemia

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Accurate characterization of anaemia is critical to understand the burden and epidemiology of this problem, for planning public health interventions, and for the care of patients across the life course. As part of the World Health Organization's (WHO) work on reviewing global recommendations for defining anaemia and its significance as a public health problem, three technical consultations were held to discuss priority topics. These topics included the variations in haemoglobin concentrations during the lifecycle; the role of elevation above sea level, smoking,

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DOI: 10.1159/000530786

infections, inflammation and genetic ancestry as determinants for adjusting haemoglobin cut-offs to define anaemia; and methods for the assessment of haemoglobin concentrations.

Previous presentations in this session will have covered a summary of the discussions on corrections in haemoglobin concentrations to account for elevation above sea level and smoking, as well as the variability in haemoglobin concentration by blood source and analytical devices. This presentation will summarize discussions on the role of infections, inflammation and genetic ancestry as possible determinants for adjusting haemoglobin concentrations, in addition to variations in haemoglobin concentrations throughout the lifecycle.

Outcomes of these technical consultations are being used to inform updated WHO guidance on the use and interpretation of haemoglobin concentrations for assessing anaemia status in individuals and populations.

Keywords: Anaemia, haemoglobin, thresholds, cut-offs, public health

SY(T2)12-1

Iron metabolism and physiologically based approaches to identify serum ferritin thresholds to define iron deficiency

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1. Columbia University (USA), 2. US Centers for Disease Control and Prevention (USA)

Our overall objective is to develop a physiologically based method to determine serum ferritin thresholds for iron deficiency. Accurate determination of iron status is vital for diagnosis, for clinical and epidemiological screening, and for assessment of pharmaceutical treatments and public health interventions for iron deficiency. Thresholds recommended in current guidelines vary considerably and are derived from statistical analyses of the distribution of serum ferritin in samples from various sources or from small studies of patients who have undergone bone marrow examination, phlebotomy, or iron treatment. We have proposed a new method for identifying serum ferritin thresholds that uses independent physiological indicators of iron deficiency, including circulating hemoglobin, serum transferrin receptor (sTfR), and erythrocyte zinc protoporphyrin (eZnPP, also known as ePP). As body iron stores decline, serum ferritin decreases. With the onset of iron deficiency without anemia, iron requirements for red cell production and tissue needs cannot be provided from stores. A multitude of homeostatic mechanisms then act to reduce the iron used for red blood cell production to conserve the supply of iron to tissue. As iron deficits worsen, the circulating hemoglobin concentration falls. Erythroid and tissue cells increase the production of cellular transferrin receptor to procure more iron. sTfR is an extracellular fragment of cellular transferrin receptor that is shed into plasma. Approximately 80% originates in the erythroid marrow. The sTfR concentration is a measure of the total body mass of cellular transferrin receptor. In the absence of erythroid hyperplasia, the sTfR concentration is a sensitive, specific, and quantitative indicator of the earliest stage of iron deficiency. In the developing red blood cell, iron deficiency decreases the iron available for insertion into protoporphyrin IX, the final step in the synthesis of hemoglobin. Divalent zinc is then incorporated instead, producing eZnPP, which persists for the life of the red blood cell as an indicator of iron deficiency. Consequently, the serum ferritin concentration at which the circulating hemoglobin concentration begins to fall and the sTfR and eZnPP concentrations begin to rise provides a physiological basis for identifying the onset of iron deficiency without anemia. As iron deficits become more severe, iron deficiency anemia develops when the circulating hemoglobin concentration falls beneath the population standard used to distinguish anemic from non-anemic states. To validate physiologically based serum ferritin thresholds for iron deficiency, harmonization of results from international studies is required and will need to take account of variation in methods, instrumentation, and other factors. The serum ferritin thresholds for iron deficiency that are determined using the physiological approach detect the onset of iron deficiency and are well above the thresholds in most current guidelines, which identify a more advanced stage of iron deficiency. Earlier recognition of the need for iron could help prevent iron deficiency from remaining untreated and help avoid progression to more severe iron deficiency and anemia. With higher serum ferritin thresholds, future prospective clinical trials would be needed to determine optimal management through dietary changes, iron fortification or supplementation, or some combination of corrective interventions.

Keywords: Iron Deficiency, Threshold, Serum Ferritin, Soluble Transferrin Receptor, US National Health and Nutrition Examination Surveys

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T2)12-2

Comparison of physiologically based ferritin thresholds for iron deficiency in healthy young children with current World Health Organization (WHO) guidelines

Zuguo Mei[1], O Yaw Addo[1], Maria E Jefferds[1], Andrea J Sharma[1], Rafael C Flores-Ayala[1], Christine M Pfeiffer[1], Gary M Brittenham[2]

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We compare physiologically based serum ferritin (SF) thresholds for iron deficiency in healthy young children with current World Health Organization guidelines (WHO, 2020). After comprehensive review, the WHO determined that insufficient data were available to revise the SF threshold of <12 µg /L for

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DOI: 10.1159/000530786

apparently healthy children <5 years of age, which is based on expert opinion dating from 1993 (https://www.who.int/vmnis/indicators/serum_ferritin.pdf). Despite the availability of international reference materials, the standardization of immunoassays for SF is complicated by the heterogeneity of antibodies used and the absence of physicochemical reference methods. To ensure comparability with the assays available at the time of the formulation of the expert opinion, we analyze data from the Third National Health and Nutrition Examination Survey (NHANES III, 1988-1994). NHANES III used the BioRad assay for SF while our previous study using the physiologically based method analyzed data from NHANES 2003-2010 and 2015-2018 using the Roche Hitachi 912 clinical analyzer (Lancet Haematol 2021;8:e572–582). The more recent NHANES study examined the relationship of SF with two independent indicators of iron deficient erythropoiesis, hemoglobin (Hb) and soluble transferrin receptor concentration and identified a SF threshold of about 20 µg /L in children 12-59 months. With the earlier NHANES III data, we examined the relationship of SF with two independent indicators of iron deficient erythropoiesis, Hb and erythrocyte zinc protoporphyrin (eZnPP). Overall, 2616 children aged 12-59 months were included after excluding anyone with infection (n=55, white blood cell counts >10.0 x 10^9/L) or at risk of iron overload (n=13, SF >150 µg /L) to define healthy individuals. We examined the distributions of median Hb and median eZnPP with SF and used restricted cubic spline (RCS) regression models to determine SF thresholds for iron deficient erythropoiesis. At lower SF, median Hb decreased as median eZnPP increased, with each varying in a curvilinear manner. Using RCS plateau points to determine the onset of iron-deficient erythropoiesis, the SF thresholds identified by Hb and eZnPP did not differ significantly and were 21.2 (95% CI: 18.5, 26.5) and 18.7 (17.9, 19.7) µg /L for children 12-59 months, respectively, much higher than the current WHO threshold of <12 µg /L. Because this study relied on data from the BioRad assay, this difference in SF thresholds for iron deficiency found using the physiologically based approach and WHO guidelines derived from expert opinion is not the result of differences in assays, as it could have been in our NHANES 2003-2010 and 2015-2018 study. Instead, we suggest that the physiologically based approach identifies the onset of iron deficient erythropoiesis while the WHO expert opinion values characterize a more advanced stage of established iron deficient erythropoiesis. Use of a higher SF threshold would increase the proportion of children < 5 years of age who are identified as iron deficient. Recognizing a need for iron in more children could help prevent the adverse effects of iron deficiency from remaining untreated and prevent progression to more severe iron deficiency and anemia.

Keywords: Iron deficiency, Ferritin, Threshold
Conflict of Interest Disclosure: None
Further Collaborators: None

SY(T2)12-3

Comparison of physiologically based ferritin thresholds for iron deficiency in healthy non-pregnant women aged 15-49 y with current World Health Organization (WHO) guidelines

Yaw Addo[1], Zuguo Mei[1], Maria Elena Jefferds[1], Andrea J Sharma[1], Rafael Flores-Ayala[1], Christine M Pfeiffer[1], Gary M Brittenham[2]

1. US Centers for Disease Control and Prevention (USA), 2. Columbia University (USA)

We compare physiologically based ferritin thresholds for iron deficiency in healthy non-pregnant women aged 15-49 y with current World Health Organization guidelines (WHO, 2020). After comprehensive review, the WHO determined insufficient data were available to revise the serum ferritin (SF) threshold of <15 µg /L for non-pregnant women which is based on expert opinion dating from 1993 (https://www.who.int/vmnis/indicators/serum_ferritin.pdf). Despite the availability of international reference materials, the standardization of immunoassays for SF is complicated by the heterogeneity of antibodies used and the absence of physicochemical reference methods. To ensure comparability with the assays available at the time of the formulation of the expert opinion, we analyze data from the Third National Health and Nutrition Examination Survey (NHANES III, 1988-1994). NHANES III used the BioRad assay for SF. In our previous NHANES analyses with data from 2003-2010 and 2015-2018, SF was assessed using the Roche Hitachi 912 clinical analyzer and the onset of iron-deficient erythropoiesis as identified by SF thresholds via hemoglobin (Hb) and soluble transferrin receptor were 25.1 and 24.0 µg /L, respectively (Lancet Haematol 2021;8: e572–582). Using NHANES III data, we examined the relationship of SF with two independent indicators of iron deficient erythropoiesis, Hb and erythrocyte zinc protoporphyrin (eZnPP). Data from 4639 apparently healthy non-pregnant women aged 15-49 y were analyzed after excluding infection (n=621, white blood cell counts <10.0 x 10^9/L), inflammation (n=17, C-reactive protein >5.0 mg/L), possible liver disease (n=35, defined by abnormal elevation of alanine amino transferase >70 U/L or aspartate amino transferase >70 U/L), and at risk of iron overload (n=312, SF >150 µg /L). Restricted cubic spline (RCS) regressions were used to determine SF thresholds for iron-deficient erythropoiesis via two separate curve models (Hb-SF and eZnPP-SF). SF concentrations increased with Hb and decreased with eZnPP in a curvilinear manner with defined inflection plateau. These plateau points were used to calculate the onset of iron-deficient erythropoiesis. The SF thresholds identified by Hb [24.8 µg /L (95% CI 23.4, 26.9)] and eZnPP [22.5 µg /L (95% CI 21.7, 23.3)] were similar (p-difference= 0.0163); both higher than the WHO threshold of <15 µg /L. Because this study relied on data from the BioRad assay, the difference in serum ferritin thresholds for iron deficiency found using the physiologically based approach and WHO guideline is not the result of differences in assays, as it could have been in our previous study. Instead, we suggest that the physiologically based approach identifies the onset of iron deficient erythropoiesis while the WHO expert

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

opinion value characterize a more advanced stage of established iron deficient erythropoiesis. The close correspondence of SF thresholds identified by two independently measured indicators further supports the evidence that iron deficiency without anemia begins well before the WHO guideline of SF <15 µg /L. Use of a higher SF threshold would increase the proportion of non-pregnant women of reproductive ages 15-49 years who are identified as iron deficient. Recognizing a need for iron among non-pregnant women could help prevent adverse effects of iron deficiency from remaining untreated and prevent the potential progression to severe iron deficiency and anemia, particularly before pregnancy.

Keywords: Iron deficiency, erythropoiesis, Anemia, Onset, Non-pregnant Women

Conflict of Interest Disclosure: None

SY(T2)12-4

Threshold ferritin and hepcidin concentrations indicating early iron deficiency in healthy infants and young women based on upregulation of iron absorption

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1. ETH Zurich (Switzerland)

Background: Plasma ferritin is a widely used indicator to detect iron deficiency, but the threshold ferritin that defines iron deficiency in women and infants remain uncertain. Our aim was to define the ferritin concentration at which the body begins to upregulate iron absorption from the diet; this could provide a functionally-defined threshold of incipient iron deficiency. We hypothesized this threshold ferritin concentration would correspond to the threshold hepcidin concentration at which iron absorption begins to increase.

Methods: We performed a pooled analysis of: 1) our stable iron isotope studies (n=1058) conducted from 2006 to 2019 in healthy, non-inflamed women (age 18-50 years; mean±SD ferritin 33.7±27.1 mg/L); and 2) our stable iron isotope studies in Kenyan and Thai infants (n=269, age 2.9 to 15.1 months); 66.8% were iron deficient and 50.4% were anemic. In all studies, we measured iron absorption from labeled test meals providing physiological amounts of iron. To fit relationships between iron absorption, ferritin and hepcidin, we used generalized additive mixed modelling (GAMM), and to identify thresholds, we estimated the first derivatives of the fitted trend to assess inflection points in these relationships.

Findings: In women, hepcidin increased linearly with increasing ferritin over the entire range of ferritin values. Iron absorption began to increase below a threshold hepcidin value of 3.09 (95%CI: 2.80, 3.38) nmol/l, above which iron absorption remained stable. Iron absorption began to increase below a threshold ferritin value of 51.1 (95%CI: 49.1, 53.1) µg /l, above which iron absorption remained stable. The latter two findings were internally consistent in that, in the relationship between hepcidin and ferritin, a hepcidin of ~3 nmol/l corresponded to a ferritin of ~51 µg /l. In infants, the fitted trend of PF versus FIA showed a significant negative slope until a PF of 46.3 (95% CI: 42.1, 50.5) µg /L, which corresponded to a FIA decrease from 26.5 to 8.3%; above this PF value, FIA remained stable. The fitted trend of hepcidin versus FIA showed a significant negative slope until a hepcidin of 3.15 (95% CI: 2.67, 3.63) nmol/L, above which FIA remained stable.

Interpretation : Based on physiological upregulation of iron absorption, threshold values indicating incipient iron deficiency are: 1) in young women, a ferritin of <50 µg /L, and a hepcidin of <3 nmol/l; 2) in infants, a ferritin of <46 µg /L and a hepcidin <3 nmol/L.

Keywords: Iron deficiency, women, ferritin, hepcidin, infant

Conflict of Interest Disclosure: None

SY(T2)12-5

Reflections on new evidence to inform serum ferritin thresholds for assessing iron status

Lisa M Rogers[1], Maria Nieves Garcia-Casal[1]

1. World Heath Organization (Switzerland)

Accurate determination of iron status is crucial for diagnostic and screening purposes in the clinical setting and to guide public health interventions at the population level. The World Health Organization (WHO) undertook an evaluation of the evidence on the use of ferritin concentrations to assess iron status in individuals and populations and published updated guidance in 2020. Serum ferritin concentrations were confirmed to be a good marker of iron stores and a valuable indicator for the diagnosis of iron deficiency in otherwise apparently healthy individuals. Although the evidence at that time was insufficient to justify a change in published cut-off values for defining iron deficiency and risk of iron overload, it was recommended that ferritin values be assessed along with a marker of inflammation, and that ferritin values in those individuals with infection or inflammation be adjusted using one of several proposed methods.

Members of the WHO guideline development group and an expert resource group identified important areas of research that may lead to improved future guidance. WHO continues to follow research developments on iron deficiency, particularly on biomarkers for its detection.

Keywords: Iron status, ferritin, thresholds, cut-offs, public health

SY(T3)1-1

Eating together throughout the lifecourse in the United States

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As you know, the United States of America is heterogeneous in demographics, philosophies, lifestyle and consequently in eating behaviors and attitudes. Thus, dietary intake ranging from vegan to organic-only to subsisting on fast foods and snacking is not surprising. However, a feature common across the dietary spectrum is the absence of *eating competence*. Eating competence (ecSatter), as devised by Ellyn Satter, is an "intra-individual approach to eating and food-related behaviors that entrains positive bio-psychosocial outcomes including maintaining energy homeostasis." Eating competent persons practice nutritional judo: They give themselves permission to eat what they want in amounts they find satisfying rather than going by dietary rules. At the same time, they exercise the positive discipline of providing themselves with regular meals and snacks. Satter suggests that this *nutritional judo* promotes movement toward a healthy lifecourse. Numerous research studies have demonstrated compelling reasons to incorporate eating competence-based counseling in educational and clinical practice. Competent eaters have been shown to have a lower body mass index, better sleep quality, more physical activity, less emotional and uncontrolled eating, lower cardiovascular risk, do better with respect to feeding their children, and to have a higher dietary quality including greater intake of fruits and vegetables. These findings are surprising given that ecSatter doesn't promote specific foods or portions or focus on weight. Instead, ecSatter addresses four pillars: Positive eating attitudes and behaviors, food acceptance skills to support increasing food variety, internal regulation of food intake, and contextual skills that enable regular and reliable meals and snacks. This session will detail each of these pillars and present research supporting their role in lifecourse and health. Finally, the development and application of a tool to measure ecSatter will be described with tool access information.

Keywords: Eating competence, mealtime plans, eating behavior, food acceptance, internal regulation of intake

Conflict of Interest Disclosure: None

SY(T3)1-2

Nurturing health, embracing conviviality: Sharing meals along the lifespan in the Mediterranean region

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Since its inception on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2010, the Mediterranean Diet (MeD) has gained recognition as an eating pattern to be emulated and promoted, not only for its health value, but also for its sustainability and socio-cultural value. The preventive and therapeutic benefits of consuming a MeD for a host of health problems and conditions, ranging from cardiovascular disease, to cancer, diabetes, metabolic syndrome, obesity, neurodegenerative diseases and frailty, amongst others, have continued to be proven ever since Professor Ancel Keys globally publicized the positive link between the MeD and cardiovascular health in the 1960s and 1970s. However, proponents of the lifestyle concept of the MeD, which started to be emphasized over recent decades and which stems from the Greek meaning of the word 'diaita' (way of life), are now highlighting even more strongly conviviality - or pleasure around meal sharing - as an integral component of the MeD, providing additional benefits for wellbeing throughout the lifecycle.

Indeed, the national dietary guidelines of a number of different countries have referred to the importance of meal sharing, indicating that there is evidence to justify such a recommendation. More specifically, in graphical food guides based on the MeD eating pattern developed in the past two decades, the requisite characteristic of conviviality involving shared food consumption and sometimes also food preparation is always portrayed. Yet whilst several studies have shown that eating with others, particularly family, is associated with healthier dietary outcomes across the lifespan, the prevalence of meal sharing and the relationship between this traditional cultural practice and physical, mental and social wellbeing for different population groups in the Mediterranean region is still an emerging area of research. Nonetheless, although research is somewhat scarce on frequency of family meals at different lifestages in Mediterranean countries, some studies have shown that sharing breakfast or family meals is a predictor for higher adherence to MeD consumption among children and adolescents in particular. Other studies have shown that high adherence to the MeD was associated with better Health-Related Quality of Life (HRQOL) and more subjective happiness among adolescents, and that, similarly, the number of meals per day consumed with the family was significantly positively associated with HRQOL as perceived by this younger generation. Of interest is one study that revealed a halo effect on non-intervention family members of an individual following a weightloss diet intervention based on the MeD. These family members also improved their diet and one of the influential factors was meal sharing.

Clearly more research is required to uncover the holistic health and wellbeing benefits for different population groups in the Mediterranean region (and beyond) of regularly experiencing conviviality as part of a MeD eating pattern and lifestyle. Sharing and enjoying meals with family and friends is a fundamental

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

characteristic of the MeD which deserves preserving, strengthening and facilitating through different educational and environmental policies, strategies and interventions.

Keywords: Mediterranean Diet, Conviviality, Family meals, Holistic health and wellbeing, Mediterranean population groups

SY(T3)1-3

The importance of eating together for a healthy life throughout the lifecourse in Japan

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Eating meals together has benefits for both children and adults in Japan. Consequently, this overview presents the recent national trends of eating together among children and adults in Japan. Additionally, the trends observed in studies concerning associations of "eating together" with behavior, health, and well-being among Japanese populations will be discussed from quantitative and qualitative viewpoints.

Results from a recent national-wide survey in Japan revealed a higher proportion of children eat meals alone at breakfast than at dinner, which also increases with school grades. Likewise, the frequency of eating together with the family among adults was higher at dinner than at breakfast and higher among females than males, particularly in young and middle-aged adults.

A systematic review was conducted in 2018 on the benefits of eating together among the Japanese population. Articles published between 2001 and 2018 were accessed using domestic and international databases (Igaku Chuo Zasshi, CiNii, J-stage, PubMed, Scopus, and Eric). After screening titles, abstracts, and full texts, a total of 62 articles matching the criteria were included in the review. Most articles were cross-sectional studies. Target populations included preschool children (n = 8), school-aged children through to university students (n = 34), and adults and the elderly (n = 20). Although the definition of "eating together" differed in the study, the most used indicator was "frequency of eating together," with whom eating meals together being "family," and the targeted meals were "breakfast and dinner." Having either "eating together" occasions or few "eating alone" chances were associated with better quality of life (QOL), subjective health, food intake, balanced diet, dietary behavior, and life rhythm across the lifecourse. The study results were shared via a brochure titled "What are the benefits of Shokuiku (food and nutrition education)?" published by the Ministry of Agriculture, Forestry, and Fisheries.

As mentioned, many studies focus on the frequency or quantity of eating together. However, some studies focused not only on the frequency but also the quality of mealtime when people are eating together. One example is a study on voluntary mealtime communication (VMC), or whether children talk by themselves at the dining table while eating meals with family. Students in the fifth and eighth grades who had family dinner ≧4 times per wee substantial VMC had more positive dietary attitudes, dietary behaviors, and quality of life (QOL) than those with less frequent family dinners or without engaging in VMC. Another study reported that the existence and compliance with rules prohibiting smartphone use at mealtimes were associated with the enjoyment of family meals among high school students. Additionally, enjoyable eating experiences in childhood were positively associated with a balanced diet, eating vegetable dishes, and subjective diet-related QOL scores in adulthood.

Studies on eating meals together among the Japanese suggested that eating together is important across the lifecourse, and both frequency and quality of mealtime should be considered when exploring better eating together occasions. More research, especially targeting adults and the elderly or focusing on meals with non-family members, is expected.

Keywords: Eating together, eating alone, health, well-being, lifecourse.

SY(T3)2-1

Overview of maternal nutrition and evidence for key interventions

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Maternal undernutrition and micronutrient deficiencies continue to be highly prevalent in many low- and middle-income countries. These conditions give rise of adverse pregnancy outcomes of low birth weight (LBW), and its two underlying causes of small-for-gestational age (SGA) and preterm birth (PTB). Annually, 20 m newborns are born with low birth weight, which increases their risk of mortality and poor postnatal growth and development. Maternal morbidity and mortality are also linked to nutritional causes including low intakes of calcium and iron that can result in increasing the risk of preeclampsia and anemia, respectively. Gestational weight gain during pregnancy is not systematically assessed but modeled estimates indicate a high burden of inadequate increase in South Asia and sub-Saharan Africa. The recent WHO antenatal care guidelines include several evidence-based interventions for nutritional support during pregnancy that need to be delivered as part of antenatal care. Counseling for healthy eating and physical activity to prevent excessive weight gain as well increased energy intake to promote increased weight gain in undernourished context is important for every pregnant woman. Universal daily iron-folic acid (IFA) with iron dosage between 30-60 mg is recommended to prevent maternal anemia, although there is low-certainty evidence for its impact on LBW. The risk reduction for maternal anemia is high at 0.30 (95%CI: 0.19-0.46), suggesting that a high proportion of anemia during pregnancy is due to iron deficiency. There is moderate-certainty evidence that balanced energy and protein supplementation (BEP) reduces SGA and stillbirths and increases birth weight by 41 g, although in stratified analysis, in undernourished populations the increase was about 100 g. BEP supplementation is recommended for use in undernourished populations. Ongoing trials of fortified, ready-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

to-use BEP supplements designed using the specifications created by an expert group consensus process (https://gatesopenresearch.org/documents/3-1498) will provide evidence for the effects of combined macro and micro-nutrients on birth outcomes. Multiple micronutrient supplements (MMS), also containing IFA and shown to be superior relative to IFA alone for reducing low birth weight, are recommended in the context of rigorous research, including implementation research. Lastly high-dose calcium (1.5-2g) is recommended for reducing the risk of preeclampsia in low intake settings. There is moderate-quality evidence showing a 64% risk reduction in preeclampsia. Ongoing non-inferiority trials will demonstrate if low-dose calcium at 500 mg will have a similar impact. In summary, nutrition guidelines for pregnancy exist, but implementation lags and "nutrition-quality" in ANC needs urgent attention. Ongoing implementation research, especially in the use of MMS and BEP in pregnancy including testing of targeting strategies will enhance our understanding of program delivery at scale.

Keywords: Pregnancy, interventions, evidence-based, antenatal care, birth outcomes

Conflict of Interest Disclosure: None

SY(T3)2-2

Periconceptional multiple micronutrient supplementation reduces risk of early pregnancy loss in rural Bangladesh: The JiVitA-5 Trial

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Background and Objectives: Micronutrient deficiencies are prevalent among pregnant women in low-middle income countries. Antenatal multiple micronutrient supplementation (MMS) can reduce adverse pregnancy outcomes, is recommended by WHO and on its Essential Medicines List. However, unknown is whether periconceptional MMS can prevent miscarriage and further improve materno-fetal health.

Methods: The JiVitA-5 trial was a double-masked, cluster-randomized, placebo-controlled trial conducted in 566 communities to assess the efficacy of MMS (15 nutrients at ~1 RDA) starting before a last menstrual period (LMP) through 1st trimester, in reducing miscarriage <24 weeks in rural Bangladesh. The trial enrolled 7,967 consenting newlyweds, of whom 4,269 became pregnant: 2,044 and 2,225 in placebo and MMS groups, respectively, similarly distributed among those detected by a (a) history of amenorrhea confirmed by urine test during pre-COVID-19 era monthly home visits (67%) and (b) history of amenorrhea and self-report of pregnancy by mobile phone interviews during the COVID-19 era (33%), after March 2020. In both randomized groups, 80% of participants began daily coded supplementation prior to their LMP, comprising the intent-to-treat group. By end of the 1st trimester, all women were switched to an open-labelled MMS through 3-months postpartum as an efficacious health intervention (West et al JAMA 2014).

Results: At baseline participants were comparable by allocation, with 86% <20 years of age. Among women who started supplementation before their LMP, the miscarriage rate (<24 weeks' gestation) was 11.53% and 8.9% in the placebo and MMS groups, yielding a relative risk (RR, design effect-adjusted 95% CI) of 0.77 (0.63-0.95, p=0.013). The RR (95% CI) of any pregnancy loss <24 weeks was 0.76 (0.64-0.91, p=0.0024). Among mothers starting coded supplementation on/after week of LMP, the RR of miscarriage was 1.10 (0.74-1.63, p=0.65), and any pregnancy loss <24 weeks was 0.96 (0.70-1.32, p=0.81). There was no apparent effect on risk of stillbirth (RR=0.89; 0.63-1.25) or preterm birth (<37 weeks, RR=0.89; 0.75-1.05).

Conclusions: Multiple micronutrient supplementation, from preconception through 1st trimester, reduced miscarriage by 23% among primigravid mothers in rural Bangladesh. Nutrients of interest include vitamins E and D, both widely deficient in rural South Asia and associated with risk of miscarriage.

Keywords: Periconceptional nutrition, Micronutrients, Miscarriage, Pregnancy loss, Bangladesh

Conflict of Interest Disclosure: None

Further Collaborators: Contributions of Md. Tanvir Islam, Parvez Mosharaf, Abdulla Al Asif, Shahnaj Parvin, Khaled Hasan, Kalpana Beesabathuni, Parul Christian, Andrew Thorne-Lyman and 650 field staff gratefully acknowledged. Funded by the Bill & Melinda Gates Foundation (Program Officer: Sun Eun Lee). DSM produced micronutrient premix. Beximco, Ltd. produced MMS and placebo supplements. Registered on ClinicalTrials.gov (NCT03921177).

SY(T3)2-3

The scale and scope of implementing maternal nutrition interventions

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This synopsis assesses the current scale and scope of maternal nutrition interventions (MNIs) to prevent or treat maternal morbidity and mortality. MNIs include micronutrient supplementation, weight-gain monitoring, dietary counseling and are efficacious in improving maternal health and birth outcomes. Globally more than 240 million women of reproductive age in low- and middle-income countries are underweight, 610 million are overweight, 571 million are anemic, and 450 million are stunted, a sign of chronic undernutrition. Deficiency rates of crucial micronutrients (such as iron, folate, vitamins B12 and D, iodine, and zinc) are high irrespective of whether women are underweight, normal weight, or overweight: 63% of women are vitamin D-deficient, 41% are zinc-

deficient, and 40% are iodine-deficient. Women require adequate access to nutritious, safe, affordable, and sustainable diets across the life course, especially during adolescence, preconception, pregnancy, and breastfeeding periods.

The Lancet's 2021 Series papers on maternal and child undernutrition progress noted that multiple micronutrient supplements (MMS) coverage is too variable and inequitable to deliver impact and thus recommended to national governments to 1) immediately scale up and routinely measure the coverage for MMS during pregnancy, and 2) prioritize efforts to acquire the implementation-related evidence required in settings with a high prevalence of maternal undernutrition and low dietary intakes of calcium and balanced energy protein supplements. Notably, despite over 20 years of evidence for the positive impact of MMS on maternal nutritional status and birth outcomes, progress on implementation has been very slow. In 2021, implementation research related to MMS integration into antenatal care services was ongoing in less than 20 countries, targeting less than two million pregnant women. Despite the recent inclusion of MMS in the WHO Model Essential Medicine List, no country has scaled up MMS distribution to the national level.

Keeping track of the scale and scope of implementing MNIs will accelerate progress toward the Sustainable Development Goals and the nutrition targets set by the World Health Assembly across countries. The maternal nutrition and maternal health communities must take collective action to accelerate the implementation of evidence-based, cost-effective MNIs. This will impact the health and well-being of the women and deliver substantial human capital gains for their babies.

Keywords: Maternal, Micronutrient, Maternal Nutrition Interventions, Multiple Micronutrient Supplements, Low and Middle-Income Countries

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T3)2-4

Antenatal multiple micronutrient supplementation; implementation lessons

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Meeting the nutritional needs of pregnant and lactating women in low and middle income countries, LMICs, remains a challenge due to the high cost, low availability, and poor access to nutrient rich diets. Multiple micronutrient supplements, MMS, containing 15 vitamins and minerals, fills this gap and has been demonstrated to be a safe, affordable, and effective intervention when it comes to improving maternal and child nutrition and health outcomes. As a growing number of countries are interested in introducing MMS to strengthen nutrition programs as part of implementation research, understanding the barriers and facilitators to implementation and uptake are paramount for successful initiation and scale up. The Improving Maternal and Pregnancy Outcomes through Vital Nutrition and Growth, IMPROVING, is a multi country project funded by the Bill and Melinda Gates Foundation. It aims to advocate for and introduce the provision of MMS for use among pregnant women in four priority countries with high burdens of maternal and child undernutrition: Burkina Faso, Bangladesh, Madagascar, and Tanzania, through existing government delivery systems. In addition, the project aims to strengthen global support systems on MMS supply chains and programmatic delivery approaches which will help guarantee the availability of MMS supplies in the four countries. The project is applying an implementation research approach to guide programming and scaling up based on lessons learned, with a special emphasis on addressing barriers to uptake and utilization of maternal nutrition services and MMS. The proposed presentation will focus on highlighting key features of IMPROVING and the implementation research approach focused on testing strategies and using routine health and nutrition data to assess how implementation is going and feed it back into system, thereby creating feedback loops in each country. In doing so, it will share evidence on the strategies and approaches being used to increase access to and utilization of MMS among pregnant women; as well as how evidence and knowledge is being tracked, consolidated, and analyzed. This result being to not only support scale up efforts in the four countries, but also other countries that become interested in introducing MMS and support a global normative transition to MMS.

Keywords: Maternal Nutrition, Micronutrient supplementation, MMS, Diets

SY(T3)2-5

Antenatal micronutrient supplementation in humanitarian settings

Philip T James[1], Natasha Lelijveld[1], Stephanie Wrottesley[1], Brenda Akwanyi[1], Eilise Brennan[1], Emily Mates[1]

1. Emergency Nutrition Network (UK)

In this short presentation we will first briefly set the scene by describing the aspects of nutrition for women and adolescent girls that are being addressed in humanitarian programmes, and specifically where multiple micronutrient supplementation (MMS) fits in. We will then use a case study to offer a snapshot of one country's specific experience across the spectrum of humanitarian programming for women, with relevant MMS programming for women's nutrition. We will summarize the views and experiences of multiple stakeholders working within that country. Firstly, we will explore how effective humanitarian programming has been, particularly the MMS programmes, as well as any barriers to access and uptake. Alongside the programmatic considerations, we will describe which policies and guidance documentation were used to guide humanitarian interventions, including MMS programming in that context, and whether stakeholders felt there were any policy gaps to fill. As part of this we will explore the extent to which it was clear when decision-makers should switch from development to

humanitarian programming or vice versa, especially if different policies exist for each context. For example, this could be the case for countries where iron-folic acid supplementation is used in developmental settings, yet MMS is used in humanitarian settings. We will consider stakeholders' perceptions on what the gaps in evidence are that may be hindering progress in nutrition programming for women and girls in humanitarian contexts. We will ask how well nutrition for women and adolescent girls, focusing on MMS, is being integrated into other health policies and/or programmes in humanitarian settings. Finally, we will summarize the lessons learnt from the case study for the wider nutrition and health communities, and what the related key priorities for progressing the nutrition agenda for women and adolescent girls in humanitarian contexts are.

Keywords: Multiple micronutrient supplementation, Humanitarian settings, Nutrition in emergencies, Antenatal care

Conflict of Interest Disclosure: None

Further Collaborators: The authors are grateful for the support of the Healthy Mothers Healthy Babies Consortium for funding in developing the case study.

SY(T3)2-6

Impact of scaling up prenatal nutrition interventions on human capital outcomes in low- and middle-income countries: a modelling analysis

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Background: Prenatal nutrition interventions can improve birth outcomes, which in turn are associated with better education and human capital potential later in life.

Objective: To estimate the impact of scaling up iron-folic acid (IFA), calcium, multiple micronutrient (MMS), and balanced energy protein (BEP) supplementation for pregnant women, on human capital outcomes in low- and middle-income countries (LMICs).

Methods: We used mathematical modelling with proportional reductions in adverse birth outcomes to estimate the potential gains in school years and lifetime income due to scaling-up each prenatal nutrition interventions separately. Estimates of intervention effects on birth outcomes were derived from meta-analyses of randomized trials. Estimates of the associations between birth outcomes and schooling and lifetime income were derived from *de novo* meta-analyses of observational studies.

Results: Across 132 LMICs, scaling up prenatal nutrition interventions to 90% coverage was estimated to increase school years and lifetime income per birth cohort by: 5.02 million years (95% uncertainty interval: 1.07, 11.0) and $18.1 billion (3.88, 39.1) for MMS; 4.08 million years (0.12, 9.68) and $18.9 billion (0.59, 44.6) for calcium; 2.28 million years (-0.44, 6.26) and $8.26 billion (-1.60, 22.4) for IFA; and 5.25 million years (-0.49, 1.70) and $1.34 billion (-1.10, 3.10) for BEP supplementation. South Asia and sub-Saharan Africa tended to have the largest estimated regional gains in school years for scaling up each intervention due to the large population size and high burden of poor birth outcomes. Income benefits for each intervention were estimated to be the largest in Latin America, where returns to education and incomes are higher relative to other regions.

Conclusion: Increasing coverage of prenatal nutrition interventions in LMICs may lead to substantial gains in schooling and lifetime income. Decision makers should consider the potential long-term human capital returns of investments in maternal nutrition.

Keywords: Prenatal nutrition interventions, iron-folic acid, calcium, multiple micronutrients, human capital

Conflict of Interest Disclosure: None

SY(T3)3-1

Protein quality and optimal intakes to prevent sarcopenia risk

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Skeletal muscle is necessary for force production in the activity of daily living, but it is also critical for the regulation of carbohydrate and fat metabolism. Sarcopenia not only increases the risk of falls but also induces insulin resistance and metabolic syndrome, which subsequently exacerbate the physical independence of older individuals.

Acute protein intake increases muscle protein synthesis which is essential for maintaining muscle protein anabolism and muscle mass. On the contrary, lack of protein intake, especially at breakfast, has been shown to increase the risk of skeletal muscle loss regardless of the age group. Essential amino acids, especially leucine, have been shown to stimulate mTORC1 pathway which subsequently regulates muscle protein synthesis. Therefore, protein quality (i.e. leucine content) is a factor that strongly influences post-prandial protein anabolism.

Resistance exercise is another intervention that can stimulate muscle protein synthesis and prevent and/or delay sarcopenia, while inactivity accelerates muscle loss. The anabolic effect of resistance exercise can last up to 48hrs post-exercise, and protein intake post-exercise can further augment exercise-induced muscle protein anabolism. Furthermore, lack of protein at breakfast negatively affects muscle hypertrophy; conversely, adding protein to breakfast and consuming sufficient amounts can enhance the effect of muscle hypertrophy.

We will review recent studies regarding the role of protein quality and optimal intake to prevent sarcopenia risk.

Keywords: Sarcopenia, protein intake, skeletal muscle, leucine, resistance exercise

SY(T3)3-2

Dietary protein: a key to active and healthy aging?

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1. Vrije Universiteit Amsterdam (Netherlands)

In this presentation, firstly, the different existing recommendations for protein intake in older adults will be reviewed, and the results of a systematic literature review of nutritional intervention studies to support the recently developed Dutch recommendation, which is similar to the recommendation from the European Food and Safety Authority. The actual intake of protein by older adults will be reviewed in light of these recommendations. Furthermore, risk groups for a lower protein intake will be highlighted based on cohort data and data from national dietary surveys. In developing nutritional advice on protein intake for older adults, information on older adults' knowledge about dietary protein is crucial. The results of an international survey on this topic conducted among 1,825 older adults will be presented. Secondly, the relationship between protein intake and physical functioning based on two recent studies will be presented. Results from a meta-analysis using pooled prospective data from almost 6000 older adults participating in four prospective cohort studies around the world will be shown. The association of protein intake with change in self-reported mobility limitations over time, as well as with change in objectively assessed walking speed over time will be described. Moreover, the effect of dietary advice to increase protein intake on 6-month change in physical functioning will be presented, using the results of the PROMISS trial, a randomized controlled trial among 276 older adults. Lastly, information will be provided on how to advice older adults to effectively increase their protein intake.

Keywords: Nutrition, Protein, Aged

Conflict of Interest Disclosure: None

Further Collaborators: The PROMISS project consortium members

SY(T3)3-3

Dietary pattern approach to stop frailty

Wen-Harn Pan[1]

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Frailty has been associated with insufficient protein intake and it has been documented that protein supplementation can significantly reverse the condition of frailty or sarcopenia. The effect may be strengthened if it is combined with physical activity intervention. Since frailty is associated with multiple nutrient insufficiency and unbalanced food group distribution, we anticipate that more can be done to manage and to prevent frailty. Foods are not consumed alone rather in patterns. Nutrients and beneficial non-nutrient food substances very often exert effects in concert. Protective dietary patterns include Mediterranean diet, DASH diet, prudent diet, and healthy Taiwanese eating approach; risky patterns include western diet and ultra-processed food patterns, etc. It points to the benefit of plant-based dietary pattern, i.e. mainly plant foods and drinks with beans and moderate amount of dairy and earth friendly sea foods as protein sources. Interventions using dietary pattern approach are limited. Promising but moderate effects have been observed in some randomized controlled trials including our Taiwanese studies. The cost-effective group activity interventions are just handful. More should be trialed out for versatile implementation needs.

Keywords: Frailty, dietary pattern, dietary intervention, plant-based diet, protein

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T3)3-4

Preventive dietary factors for frailty, sarcopenia, and dementia; Results from NILS-LSA cohort study

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1. National Center for Geriatrics and Gerontology (Japan)

In aged societies, the number of older people with physical frailty, sarcopenia and dementia is increasing. Nutrition is one of the key factors to prevent these age-related impairments. The National Institute for Longevity Sciences - Longitudinal Study of Aging (NILS-LSA), a comprehensive longitudinal epidemiological study of aging, started in 1997 at the National Center for Geriatrics and Gerontology (NCGG) in Aichi Prefecture, Japan. Participants in this study were 2,300 residents aged 40-79 years who were age- and sex-stratified random samples selected from the area around the NCGG. Participants were examined at the NCGG examination center every 2 years from 1997 to 2012 and were followed-up from 2012 to 2022.

Nutrition and food intakes were calculated based on 3-day dietary records with photographs. Physical frailty was assessed using the modified criteria of the Cardiovascular Health Study, which included weight loss, weakness, exhaustion, slow walking speed, and low physical activity. Muscle mass was assessed using dual-energy X-ray absorptiometry, and low muscle mass was defined as skeletal muscle mass index <7.0 for men and <5.4 kg/m^2 for women. Cognitive function was assessed by the Mini-Mental State Examination for participants ≧60 years old.

This presentation will show the key nutritional findings from the NILS-LSA. Prospective analyses of the NILS-LSA cohort showed that higher meat and dairy consumption to ensure sufficient protein and fat intake (to achieve higher energy intake levels) may be an appropriate option to help prevent the development of physical frailty. And high levels of daily protein intake and protein intake at lunch may help prevent skeletal muscle mass declines. In addition, compared to less varied diets,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

moderately to highly varied diets containing fish, soybeans, and dairy products prevented cognitive decline.

These findings suggest that a daily diet that includes a variety of foods with sufficient protein and fat might be effective for preventing physical frailty, sarcopenia, and dementia in the Japanese community.

Keywords: Diet, Physical frailty, Sarcopenia, Cognitive function, Older adults

Conflict of Interest Disclosure: None

SY(T3)4

Counseling is Complex: Approaches and Tools to Improve Infant and Young Child Feeding Counseling Quality

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1. JSI Research & Training Institute, Inc (USA), 2. Save the Children (USA), 3. USAID (USA), 4. UNICEF (USA)

Background and Objective: The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) define nutrition counseling as “a way of working with people so that you understand their feelings and help them to develop confidence and decide what to do.” Providing quality counseling is an effective means to achieve optimal infant and young child feeding (IYCF) practices, identified by WHO as a key approach to improve breastfeeding rates globally. However, long-standing barriers (e.g. overburdened workforces, insufficient counselor capacity, poor remuneration, inadequate supervision and support, and lack of prioritization/funding) continue to affect the provision of quality counseling, highlighting the complexity of effective implementation. These challenges underscore the need for more practical information, guidance, and tools to support effective IYCF counseling. The purpose of this session is to facilitate discussion and sharing of resources on how to improve the quality of IYCF counseling.

Methods: This informative, interactive session will utilize presentations, storytelling, and facilitated discussion. We begin by sharing counseling experiences and presentations from the U.S. Agency for International Development (USAID) and UNICEF highlighting approaches to strengthening counseling, including key considerations, barriers, and opportunities. Participants break into groups to discuss areas to improve IYCF counseling: 1) capacity strengthening (e.g. training, mentorship); 2) support to counselor performance (e.g. tools, job aids, supervision); 3) support to caregiver enabling environment (e.g. resources for family engagement, caregiving evidence measures). Handouts provide additional examples of tools and resources from USAID Advancing Nutrition, the Agency's flagship multi-sectoral nutrition project, UNICEF, and others. The session concludes by highlighting areas of discussion, applications to current work, and next steps.

Results: This session aims to improve understanding of the challenges that impede effective counseling implementation, and identify key approaches, tools, and resources that can address barriers to quality IYCF counseling.

Conclusions: Despite the importance of counseling in supporting optimal IYCF practices, long-standing barriers limit the provision of quality IYCF counseling to the detriment of families, communities, and countries. Focused discussion on how to address key barriers to effective counseling is critical to improving IYCF practices and ultimately nutrition outcomes.

Keywords: Counseling, infant and young child feeding, breastfeeding, resources, tools

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T3)5-1

Preconception diet for healthy pregnancy outcomes

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Improving nutritional status during the "first 1000 days of life" is important because the fetal to early postnatal environment has a strong impact on lifelong health (https://thousanddays.org/). On the other hand, preconception health care is important because even if women intervene in nutrition and lifestyle after becoming pregnant, their effects on pregnancy outcomes are limited. For example, undernutrition in pre-pregnancy women causes premature birth and low birth weight infants and is associated with future metabolic syndrome, and overweight and obesity in pre-pregnancy women are large for gestational age infants, gestational diabetes, and preeclampsia. The Lancet magazine highlighted the need for preconception interventions in nutrition, while discussing the difficulty of interventions in care recipients (Lancet, 391 (10132), 2018). In the United States, since 2006, the PCHHC Initiative, which consists of related organizations, has been increasing interest in the health of the younger generation while involving companies (Upsala Journal of Medical Sciences, 2016.DOI: 10.1080 / 03009734.2016.1204395). In Japan, the increase in the proportion of underweight (BMI <18.5) among young women during the period from the 1980s to the quarter century from 15% to over 20% and the decrease in the average birth weight of children born are regarded as problems. On the other hand, the proportion of overweight / obesity (BMI > = 25) in young women is on the rise (about 10%). According to data from the Japan Environment and Children's Study (JECS), which enrolled approximately 100,000 pregnant women in 15 locations nationwide over the three years from 2010, the regional difference in the proportion of overweight / obese pregnant women is as large as 7.3% (Journal of Epidemiology 2018; 28:99). Furthermore, there are some areas where the ratio of overweight / obesity pregnant women is higher than that of underweight pregnant women, and not only the increase in

underweight but also the overweight / obesity of young women is a big problem. The low intake of appropriate folic acid supplements for women of reproductive age (8.3%) (Congenit Anom. 2019; 59: 110) is also one of problems. In Japan, double burden of nutrition has become a problem within individuals, households and populations, and urgent measures are required considering the short-term and long-term effects on children.

Keywords: Nutrition, preconception care, double burden of nutrition

SY(T3)5-2

Maternal & child health service delivery in Sri Lanka

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Sri Lanka is a low and middle income country, with a population of 22 million, located in the Indian subcontinent. The country boasts of impressive maternal and child health (MCH) indices on par with high income countries. In the year 2020, there were 301,706 live births and a maternal mortality ratio of 30.2 (per 100,000 live births) was reported. The country's neonatal mortality, infant mortality and under 5 mortality rates were 6.0, 8.5 and 10.1 (per 1000 live births) respectively (2015). The secret behind the success is the strong maternal & child health service delivery system operative throughout the country.

The public health sector dominates in the MCH service delivery and is structured into two parallel systems with community health services and curative care delivered through a variety of hospitals. Started in the year 1926, the MCH programme has been evolved over many decades. The service delivery is based on the life course approach starting from the registration of newborns by field healthcare workers at home. Domiciliary and institution based care is provided for infants, preschool children, school children, adolescents, pre-pregnant women and pregnant women. All the service recipients are registered and followed up at household level by a hierarchy of healthcare providers at strategic points with a parallelly running health information system. Currently, it has reached almost all families in the country forming a well organized health care network with 354 divisional areas.

The country's MCH service delivery model is inbuilt with nutritional action points starting from birth, exclusive breastfeeding, Infant and young child feeding (IYCF) program for under 2 years, community-based growth monitoring, provision of supplementary food, institutional management of severe wasting, school medical inspections, adolescent healthcare, prepregnant care package and maternal nutrition monitoring and interventions.

The outcomes are satisfactory; low birth rate (16.1%), Exclusive breastfeeding under 6 months (82%), Children ever breastfed of all children <5 years (99.4%), Children under five: Underweight (weight- for- age <-2SD) (20.5%), Wasting (weight for height <-2SD)(15.1%) and Chronic malnutrition (height for age <-2SD) (17.3%), at 12 weeks of gestation maternal BMI < 18.5 (16%), BMI > 25 (29.9%) and Hb % below 11g/dl (18.4%), 7.6 % and 5.6% of school children in grades 1 and 4 are stunted respectively.

Sri Lanka executes a well organized MCH program addressing nutritional demands of the service recipients.

Keywords: Sri Lanka, maternal and child health

Conflict of Interest Disclosure: None

SY(T3)5-3

WHO global recommendations for improving health through maternal nutrition

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Good maternal nutrition supports the protection and promotion of health through improved well-being of women, especially during the preconception, pregnancy and postpartum periods. This provides beneficial effects starting at the earliest stages of the life course, during fetal development and early life – having both short- and longer-term effects.

This presentation will highlight existing WHO global recommendations on maternal nutrition, underlining opportunities for action on maternal health. Actions related to women prior to pregnancy, as well during the antenatal, intrapartum and postpartum periods, will be presented in which countries may wish to choose to adapt while developing their own maternal health policies and programmes. These actions are targeted to women for her benefit and the benefit of the child. By contributing to the well-being of women, we can support mothers who are healthy, happy and better able to nurture their child, while reaching Sustainable Development Goal 3 (Ensure healthy lives and promote well-being for all at all ages) and its associated targets on reducing global preventable maternal and newborn mortality.

Keywords: Maternal health, nutrition, pregnancy, postnatal, public health

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T3)5-4

Revised dietary guidelines for pregnant and lactating women in Japan

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Numerous previous studies suggest that impaired fetal growth poses the infant to increased risk of non-communicable disease, such as obesity, cardiovascular disease, and type 2 diabetes. In Japan, approximately 10 % of newborn infants are born low birthweight. The unique characteristic of these low birthweight infants is, that around 60% of them are term born, according to the 2020 Vital Statistics data. Furthermore, the relatively high proportion (nearly one in five) of underweight young women in Japan, who may have the increased risk of malnutrition, may be one of the underlying factors for impaired fetal growth among Japanese infants. Therefore, improving the nutritional status of pregnant and lactating mothers is a priority for promoting the health of future generations. However, results from nutritional intervention studies on pregnant and lactating mothers aimed at improving pregnancy outcomes or infant growth are non-consistent. One reason may be that pre-pregnancy nutritional status of the women is more influential than short term dietary improvements. Prior to the revision of the "Dietary guidelines for pregnant and lactating women" in 2021, we conducted systematic reviews regarding nutrition and diet among East Asian women in a 2019 research project, to provide evidence for this revision. We share our experience in the revision process of the "Dietary guidelines".

Keywords: Pregnancy, lactation, dietary guidelines

Conflict of Interest Disclosure: None

Further Collaborators: Drs. Kayo Kurotani, Yoko Sato, Chisa Shinsugi, and Chika Okada

SY(T3)6-1

Infant nutrition for growth and future health

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Early nutrition and lifestyle factors acting during sensitive pre- and postnatal time windows of developmental plasticity have long-lasting programming effects on later health, performance and disease risks. Early growth trajectories modulate later risks of obesity, adiposity, and associated non-communicable diseases (NCDs). Improved early nutrition offers major preventive opportunities. Rapid weight gain in the first two years of life is associated with increased later obesity. Breastfeeding is associated with reduced later obesity, compared to infant formula feeding. We explored the hypothesis that the lower protein content of human milk, as compared to conventional formula, results in lesser infant weight gain and body fat deposition (*The Early Protein Hypothesis*) (1) in a large double blind randomized clinical trial (2-4) with conventional bottle milk, or isoenergetic intervention formula with reduced protein content more similar to contents in human milk. The reduced protein supply normalized body weight and Body-Mass-Index (BMI) at age 2 yrs, compared to breastfed children. The beneficial effect on BMI persisted until school age. At 6 yrs, the adjusted relative obesity risk of children previously fed high protein formula was 2.60fold higher than with a reduced infant protein intake (3). Follow up at 11 yrs showed persistent effects. Lower protein supply reduced IGF-1 and insulin secretion which predicted weight gain (5). Dietary effects on the IGF-1 axis outweighed by far the effects of genetics and gender (6). High protein supply appeared to suppress fatty acid beta-oxidation (7), which may explain increased body fat deposition and adiposity at ages 2 and 6 yrs (4). Metabolomic and amino acid data suggest that also protein quality provided in infancy is important for modulating growth, providing further opportunities for early prevention. We tested a formula with a modified amino acid composition better matching infant amino acid requirements, first in an animal study to evaluate safety (8, 9) followed by a randomized trial in infants (10-12).

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Keywords: Metabolic programming of adult health and disease, infant nutritional physiological phenomena, child nutrition sciences, obesity prevention, metabolomics

SY(T3)6-2

Early nutrition and later outcomes in preterm infants

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Many studies have shown a positive association between nutritional intake during the neonatal intensive care unit (NICU) stay and the long-term neurodevelopmental outcomes at 18 months of corrected age (CA) and beyond in preterm infants. The association is, however, confounded by several factors, including maternal nutrition and socioeconomic status, obstetric

conditions like gestational diabetes and hypertension, fetal genetic potential, and, importantly, neonatal morbidities such as bronchopulmonary dysplasia and preterm brain injury. These factors are likely to play a more critical role in delineating the association between early nutrition and long-term outcomes in preterm infants from low- and middle-income countries (LMIC) with suboptimal antenatal and neonatal care practices and high prevalence of intrauterine growth restriction. For example, the growth trajectory from birth to term corrected age in preterm infants in LMIC settings is quite different from those born in high-income countries. In a study involving about 400 preterm neonates born before 34 weeks of gestation, we found a considerable drop in weight-for-age z-scores from around -0.8 z-score at birth to -2.8 z-score at term corrected age despite receiving adequate parenteral and enteral nutrition at a level-3 NICU in India. Despite some catch-up during infancy, the median z-score was -1.6 at 12 months of CA. In another study of 195 very preterm or very low birth weight infants, we observed no association between the average energy and protein intake during the NICU stay and the weight-for-age z-scores at 18 months' CA. Though there was a weak positive correlation between the weight-for-age z-scores at term corrected age and the motor and mental developmental quotients (MoDQ and MeDQ) at 18 months' CA, the multivariable regression did not demonstrate any association between the two variables after adjusting for gender and gestation. The effect of nutritional intake before discharge from the NICU on the risk of metabolic syndromes in later life is largely unknown in preterm infants from LMICs. The paucity of information underscores the need for large observational studies with well-defined protocols and methodologies to examine the association between early nutrition and long-term growth and development and the risk of adult-onset diseases after accounting for all relevant confounding factors in preterm infants from both high-income and low and middle-income countries.

Keywords: Newborn, prematurity, nutrition, development

SY(T3)6-3

Dietary exposures among infants in the United States

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Establishing optimal dietary patterns in early childhood is critical not only to support optimal growth and development, but also to promote life-long health. Using nationally-representative survey data in the US, the dietary patterns and feeding behaviors of older infants (i.e., 6 to <12 months), when complementary foods and beverages [CFB] are recommended to be introduced, are summarized. Breastfeeding initiation is high (84%), but the prevalence of exclusive breastfeeding at 6 months (26%) is below the Healthy People 2030 goal (42%). Most U.S. infants consume CFB prior to 6 months (51%). Indeed, about one-third (32%) of infants are provided CFB prior to 4 months, which is higher among formula-fed (42%) when compared with mixed-fed (32%), or exclusively breast-fed infants (19%). Formula- and mixed-fed [FMF] infants are more likely to receive cow's milk (36% vs. 24%) and fruit juice (45% vs. 20%) at <12 months than human-milk-fed [HMF] infants, respectively. The primary mode of feeding is associated with the timing of introduction and types of CFB reported. FMF are more likely to consume grains (91% vs. 81%), proteins (51% vs. 35%), fruits (86% vs. 75%), dairy (46% vs 40%), fats (62% vs. 49%), and added sugars (64% vs 55%) than their HMF counterparts. HMF infants consume more fruit from non-baby food sources, more grains from snacks and sweets, and less total protein foods than FMF infants. HMF infants obtain more oils from vegetables and less from snacks/sweets, mixed dishes, and baby foods than FMF infants. HMF infants receive more energy from fruits, vegetables, milk and dairy, and grains and less energy from mixed dishes than FMF infants. These dietary patterns result in differences in amounts of total energy (845 vs. 631 kcal), protein (22 vs. 12 g), and sodium (508 vs 305mg) from all sources, and more energy (345 vs. 204 kcal), protein (11 vs. 6 g), and sodium (344 vs 201 mg) from CFB alone. HMF have a higher prevalence of risk of inadequate intakes of iron (77% vs. 7%), zinc (54% vs. <3%), and protein (27% vs. <3%) than FMF infants. Taken together, these data suggest that the primary mode of feeding plays a critical role in the timing, amounts, and energy and nutrient intakes from CFB. CFB are needed to provide more than half of the infant's requirements for vitamins B6, D, E, thiamin, and niacin, iron, zinc, magnesium, phosphorus, manganese, and fluoride, but this varies by the amounts and combinations of human milk and infant formula. Given the estimated calorie requirements during this life stage, it can be quite challenging to meet these nutrient requirements without careful consideration of choices for CFB. Given, the large differences in energy intakes relative to recommendations, tailored advice for providing CFBs is needed by mode of feeding to reduce the risk of pediatric overweight and obesity and to support infants' nutrient adequacy.

Keywords: Infants, complementary feeding, dietary intakes, NHANES

SY(T3)6-4

Promoting Healthy Food Preferences from Early Life - Flavor Perception and Preference Development

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To understand the development of children's flavor preferences, it is important to consider the interplay of nature and nurture. Children are biologically predisposed to prefer sweet-tasting foods and beverages and to avoid bitter-tasting foods such as green leafy vegetables. In addition, food neophobia, or the avoidance of new foods, increases during early childhood and by the end of the second year, food refusals become common. In today's obesogenic environment these

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

biological predispositions place children at risk for a variety of serious health consequences, such as type 2 diabetes, cardiovascular disease, and heightened risk of obesity. Although early preference for sweet taste and avoidance of bitter taste are inborn, an important feature of the olfactory and gustatory systems is that they are inherently plastic, especially during infancy and childhood. Throughout development parents play an important role in setting the stage for healthy food acceptance patterns. Before birth, the gustatory and olfactory systems are well developed, allowing the fetus to detect the continually changing flavor profile of amniotic fluid, which reflects the mother's diet. These sensory experiences continue after birth if the mother chooses to breastfeed. Through this process of familiarization, women who maintain a healthy diet throughout pregnancy and lactation expose infants to the flavors of these healthful foods and prepare their infants to like them after birth. This process continues once infants begin to eat complementary foods. Repeated exposure to a variety of healthful foods further promotes preferences for these foods and also encourages acceptance of novel foods. By modeling healthy eating behaviors and by creating supportive feeding environments, parents can shape their children's flavor preferences. Although this developmental process may seem relatively simple, it is important to remember that these practices are influenced by demographic and societal characteristics. By considering the context in which children and families live, more effective evidence-based strategies can be developed to empower a broader population of parents and caregivers to encourage healthy eating in young children's everyday environments.

Keywords: Olfactory development, taste development, plasticity, repeated exposure

SY(T3)7

Introducing multiple micronutrient supplementation (MMS) for improved maternal nutrition in low- and middle-income countries

Kristen Hurley[1,2], Ruchika Chugh Sachdeva[3], Parul Christian[1], Martin Mwangi[4], Toslim Uddin Khan[5], Trisari Anggondowati[6], Aissata Ba[7]

1. Johns Hopkins Bloomberg School of Public Health (USA), 2. Vitamin Angel Alliance (USA), 3. Bill and Melinda Gates Foundation (India), 4. Healthy Mothers Healthy Babies Consortium (USA), 5. Social Marketing Company (SMC) (Bangladesh), 6. Universitas Indonesia (Indonesia), 7. jhpiego (Mali)

The United Nations International Multiple Micronutrient Antenatal Preparation of Multiple Micronutrient Supplements (UNIMMAP MMS) is a nutritional supplement for pregnant women. It contains 15 essential vitamins and minerals (including iron and folic acid) for pregnant women; and is supported by more than 20 years of research showing that it safely and effectively improves maternal health and pregnancy outcomes above and beyond that of Iron and Folic Acid (IFA). This evidence informed the 2020 update to the WHO antenatal care recommendations for UNIMMAP MMS. The new guidelines now recommend the use of MMS containing iron and folic acid in the context of rigorous research (context-specific recommendation – research). At a program level, UNIMMAP MMS are recommended to be introduced into antenatal care services, informed by implementation research (IR) including an evaluation of acceptability, feasibility, sustainability, equity, and cost-effectiveness of switching from IFA to MMS.

More recently, in October 2021, WHO included MMS in the Model List of Essential Medicines (EML) based on the strong evidence that it is a safe and effective intervention and is available now for inclusion in antenatal care programs. Inclusion of UNIMMAP MMS on WHO's EML and its implications for inclusion on national EMLs is a significant step forward for procurement, supply, implementation research efforts, and ultimately for wider accessibility and use of UNIMMAP MMS.

As a result, the number of countries exploring UNIMMAP MMS introduction is increasing, and new findings and lessons learned have emerged. These experiences emphasize the importance of exploring UNIMMAP MMS introduction using an implementation science approach. Presenters will share the latest results from national level UNIMMAP MMS implementation science activities, including from Bangladesh, Indonesia, and Mali. Each country case study will share lessons learned related to building an enabling environment (via landscaping and advocacy efforts) for UNIMMAP MMS, formative research results, and/or the co-design and testing of different implementation strategies. After the presentations, presenters will answer questions from the audience.

Keywords: Maternal Health, Infant Nutrition, Maternal Nutrition, Multiple Micronutrient Supplements (MMS), Anemia

SY(T3)8

Aligning Newborn and Nutrition Priorities to Save Infant Lives

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1. PATH (USA)

PATH is a global health NGO, with globally recognized expertise across the nutrition spectrum. A key area of our focus is in the gap that currently exists in nutrition and lactation related to small and sick newborns. This remains a massive challenge, largely due to the disparate fields of nutrition and newborn care – often not interlinking at a programmatic, implementation, policy and funding level. As a result, optimal systems to ensure these infants receive human milk or that their mothers receive specialized lactation support are often lacking – especially in LMIC settings. PATH is a global leader in this space, advocating across the fields to bring together a shared vision of including newborn nutrition as a key component in the care of the small and sick newborn. ICN2022 presents a unique and powerful platform to further advocate for this linkage. In this special session, we will focus on the topic 'Aligning Newborn and Nutrition Priorities to Save Infant Lives' including a round table discussion with newborn and nutrition technical/policy leads and

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DOI: 10.1159/000530786

importantly the country perspective with representatives from key Ministries of Health. Topics for discussion will include the specific gaps in the current field, the potential for alignment of newborn and nutrition indicators and implementation guidance for a shared story, and the needed package of support materials that are required to facilitate this linkage at the systems level.

Keywords: Breastfeeding, small and sick newborn, donor human milk, neonatal mortality

Conflict of Interest Disclosure: None

SY(T3)9-1

Fish and Chronic Disease Prevention

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Background: Chronic non-communicable diseases (NCDs) represent one of the major health and development challenges of the 21st century and are the leading cause of death worldwide (GBD, 2020). Forty-one million deaths per year are due to NCDs, accounting for 71% of deaths worldwide. Most NCD deaths are potentially preventable; they last a long time and generally progress slowly (WHO, 2014). The type of fat in the diet can influence, directly or indirectly, some of the mediators of the inflammatory response involved in the development of NCDs (Gil et al. 2012). Fishery products are the main source of n-3 (also known as omega-3) long-chain polyunsaturated fatty acids (LC-PUFA) in the diet (FAO/WHO, 2010). The nutritional importance of n-3 LC-PUFA and in particular eicosapentaenoic acid (EPA, 20:5 n-3) and docosahexaenoic acid (DHA, 22:6 n-3), derives from their metabolic implications in different physiological and pathological mechanisms. LC-PUFA n-3 are present in membranes and influence their structure and functions. They are key nutrients for growth and maturation during pregnancy and early life. In addition, they are precursors of many anti-inflammatory mediators, i.e. eicosanoids and docosanoids, and also modulate the expression of key genes.

Objectives: The present study aimed to review the nutritional importance of n-3 LC-PUFA and in particular EPA and DHA in the prevention of NCDs and provide data of fatty acid profiles from fish consumed in Spain and how they contribute to international dietary recommendations.

Methods: Review of current literature on the effects of n-3 LC-PUFA on the prevention of NCDs using data search in public databases such as PubMed, EMBASE, Scopus, Web of Science, and the Cochrane Library Collaboration, and analysis by GLC of fatty acid profiles on Spanish fish and mollusks.

Results: n-3 LC-PUFA contribute to the prevention and treatment of NCDs of inflammatory origin, such as cardiovascular disease, cancer, lung disease, and inflammatory bowel disease (Gil et al. 2012). In addition, n-3 LC-PUFA reduces plasma triacylglycerols and lower blood pressure, as well as regulates thrombogenesis. Our results obtained in fish of Spanish origin confirm the high levels of variation in the fatty acid content of the different species of fish products that provide a substantial amount of LC-PUFA n-3, mainly DHA (Gil et a al. 2015; Mesa et al. 2021). Due to this variation, the consumption of 2 to 3 servings per week of a variety of fish products may help to meet the recommended daily intake of LC-PUFA n-3 in adults, including pregnant and lactating women, and also contribute to the prevention of NCDs of inflammatory origin.

Conclusions: Adequate consumption of n-3 LC-PUFA seems to contribute to the prevention of NCDs.

Keywords: Fish, Chronic non-communicable diseases, Docosahexaenoic acid (DHA), Eicosapentaenoic acid (EPA), Polyunsaturated fatty acids, omega-3

Conflict of Interest Disclosure: None

SY(T3)9-2

Diet Quality and Health in the Japanese Population

Kayo Kurotani[1]

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Japan is one of the highest countries with average life expectancy and healthy life expectancy. There are some reasons for longevity in Japan, such as socioeconomic factors, the medical system, and diet. Japanese cuisine, called Washoku in Japanese, was recognized by UNESCO as an intangible cultural heritage in 2013. Fish is necessary for Japanese cuisine. The Ministry of Health, Labour and Welfare and the Ministry of Agriculture, Forestry and Fisheries jointly developed the "Japanese Food Guide Spinning Top" as a practical and easy way to improve eating habits for all the people. The recommended amounts of dishes (grain dishes, vegetable dishes, fish and meat dishes, milk, and fruit) were drawn in descending order of intake in the Spinning Top. To clarify the effect of diet on longevity, we examined the association between adherence to the Food Guide and mortality in population-based surveys all over Japan in Japan Public Health Center-based prospective study (JPHC study). We found that individuals with closer adherence to the Japanese Food Guide (those with higher diet quality) had a lower risk of mortality, especially mortality from cardiovascular diseases, and cerebrovascular diseases (Kurotani et al. 2016). Similar associations were obtained among Japanese women in a prospective cohort study (Oba et al. 2009). In a longitudinal study, men with higher adherence to the Japanese Food Guide Spinning Top were more likely to have a higher skeletal mass index (SMI) than the Japanese elderly (Huang et al. 2021). A cross-sectional study showed an inverse dose-response relationship between diet quality and prevalence of both physical and comprehensive frailty in older adults (Watanabe et al. 2022). Additionally, a cross-sectional study of young Japanese women showed that higher adherence to the Japanese Food Guide Spinning Top was associated with lower waist circumference and LDL-cholesterol concentrations (Nishimura et al. 2015). This evidence suggests the benefits of the Japanese Food Guide Spinning Top, which was characterized by favorable dietary intakes of foods and nutrients as well as lower energy density. Balanced consumption of foods adhering to the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Japanese Food Guide can contribute to health, especially by encouraging the intake of vegetable dishes and fruits that are often insufficient.

Keywords: Diet quality, Japanese Food Guide Spinning Top, Japan, longevity, health

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T3)9-3

Atlantic Diet: Fish, Health and sustainability

Rosaura Leis[1]

1. University of Santiago de Compostela/Atlantic Diet Foundation (Spain)

Atlantic Diet is the diet of the countries bathed by the Atlantic Ocean, being its maximum representatives Galicia, Autonomous Community of Northwest of Spain and North of Portugal. It is characterized by the consumption of seasonal, local, fresh and minimally processed foods, with a culinary preparation in which steaming and boiling predominate over frying and where enjoyment and social relations around the table take center stage. The consumption of fish and shellfish in Atlantic Diet is high. These foods provide proteins of high biological value, vitamins and minerals, and omega-3 fatty acids. Multiple studies link this higher consumption in the earliest years with beneficial effects for the development of the brain and retina and throughout life with better cardiovascular and metabolic health. The expectation and quality of life in Galicia is higher, related to the Atlantic lifestyles. However, we are witnessing an increase in prevalence of obesity and comorbidities, especially in children and adolescents, associated with loss of adherence to our traditional eating patterns. This fact could cause them to live less and with worse quality than their grandparents. Intervention, centered on the child, the family and the school and involving the whole of society, is necessary. We must increase adherence to our culinary traditions from the earliest years. GALIAT study, a recent randomized clinical trial, carried out in families with Atlantic Diet, from primary care health center and involving the municipality and entire community, has observed after 6 months of intervention, a decrease in BMI and a lipid status and healthier inflammatory In addition, recent studies show that Atlantic diet is among the most sustainable, with a low carbon and water footprint. Fish and sea products have a water footprint of 0 and their carbon footprint is also low, because we consume products from our coasts. Therefore, the traditional Atlantic Diet is healthy for individual and environment. We must establish strategies to promote Atlantic lifestyles and consumption of its characteristic foods such as fish and shellfish from childhood to elderly.

Keywords: Atlantic Diet, Sea, Fish, Galicia, Health and sustainability

Conflict of Interest Disclosure: None

SY(T3)10-1

Work-related and work-environmental factors that influence diet: a Japanese perspective.

Mieko Nakamura[1]

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Workers' diets are associated with various factors, including work-related and work-environmental factors, in addition to personal lifestyle and preferences. The most evident work-related factor affecting diet was shift work, including late-night shift. Shift workers are at a high risk of obesity, cardiovascular disease, and type 2 diabetes. However, the quantity and quality of dietary intake among shift workers are still controversial. We previously reported that shift workers were more likely to be overweight, consume high total energy and low dietary fiber, vitamin B_2, folic acid, vitamin C, potassium, calcium, magnesium, and iron than daytime workers in Japan's manufacturing companies (Nakamura, et al. J Occup Health, 2018). In addition, irregular dinner timing among daytime and shift workers was also associated with a low intake of some nutrients in this study. Moreover, long working hours and commuting time also affect workers' diets, including breakfast skipping and late dinner time. Regarding work-environmental factors, menus and the prices offered in workplace cafeterias also affected the dietary intake of workers. A recent topic of behavioral and environmental factors in the workplace cafeteria is coronavirus disease 2019 (COVID-19) related regulation. During the COVID-19 pandemic, infection control regulations, including short lunchtime and avoiding crowded spaces in the workplace cafeterias, affected workers' dietary intake. We reported fewer cafeteria visits and reduced intake of vegetables per cafeteria visit under COVID-19 related infection control regulations in a Japanese manufacturing factory (Nakamura, et al. Nutrients, 2021). Although it is essential to take preventive countermeasures against COVID-19 in eating and drinking places, prolonged regulations could worsen employee nutrient intake and health status. In addition, providing nutritious menus and their nutritional information could positively impact dietary intake and employee health (Shirai, et al, Food & Function, 2022). Various barriers need to be removed to enable workers to eat a healthy diet under their working conditions and dietary environment in the workplace.

Keywords: Shift work, Meal timing, Workplace cafeteria, Nutritious menus, Nutritional information

Conflict of Interest Disclosure: Mieko Nakamura received research funding from Toyota Motor Corporation.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T3)10-2

The effect of educational background music on reducing salt intake at a university canteen

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Objective: It is necessary to establish population approach for healthy low-risk people compared to conventionally tailored interventions for high-risk people, considering young people's lifestyle. Particularly, in countries, such as Japan, Korea, and China, where the primary sources of salt are soups and discretionary seasonings added to homemade foods or cooked foods already at the table (i.e., soy sauce and *miso*), public approaches raising the individual's awareness on reducing salt intake may be effective. For instance, a song that encourages salt intake reduction consisting of interesting sound and lyrics was developed as an educational tool by the government of Nara Prefecture(1). Use of educational songs as background music (BGM) is potentially becoming a common and versatile approach in food purchasing and/or eating environments to nudge consumers toward healthier choices. Thus, we examined the effect of a dietary educational song as BGM on individual salt related behavioral modification at a university canteen. This was conducted by comparing the control and intervention periods (2).

Design: The study design is a small-scale community trial that compared the control and the intervention periods. Subjects were unspecified consumers at a university canteen Interventions. We displayed visual materials at a university canteen for 5 weeks (control period) and then broadcasted BGM for another 5 weeks (intervention period). Measures of outcome were the consumption amount of discretionary seasonings, the consumption amount of soup in noodles, the consumption number of soup bowls, and the consumption number of noodles among the consumers. The changes in the four outcome indices during both periods were compared by Mann–Whitney U test.

Results: Reductions in the consumption number of soup bowls and noodles were higher in the intervention period than those in the control period with statistical significance (median values: −7.5 and 5.4 per 100 rice consumers, p = 0.01; ratios to rice consumers, −0.02 and 0.10, p = 0.02, respectively).

Conclusion: Using a dietary education song on salt intake as BGM may be effective in influencing individuals toward healthier menu choices rather than seasoning behavior at a university's canteen. However, these results based on representative values for unspecified users of the canteen over a short intervention period should be interpreted with caution.

1) Nara Prefecture. Tools for reduced salt. http://www.pref.nara.jp/item/142355.htm: Nara Prefecture. (Japanese) [accessed August 15, 2019]

2) Maruya S, Sato Y, Nakai H and Takachi R. The effect of educational background music on reducing salt intake at a university canteen. Open Access J Public Health. 2019;2(4):028.

Keywords: Behavior modification, BGM, Population approach, Reduced salt diet

SY(T3)10-3

A school-based education programme to reduce salt intake in children and their families (School-EduSalt): Results from a cluster randomised controlled trial

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Objective: To determine effect and cost-effectiveness of an school-based health education programme in lowering salt intake and blood pressure (BP) and social network influencers of the intervention effect in children and their families.

Methods: A health education programme targeting on school students with the aim to reduce salt intake in their families was developed. The effect and cost-effectiveness of the intervention was tested with a cluster randomised controlled trial in 28 primary schools in urban Changzhi, northern China (Trial registration: ClinicalTrials.gov NCT01821144). Participants included 279 children in Grade 5 of primary schools and 553 adult family members. Children in the intervention group received the intervention with 3 interactive lectures and 5 themed activities built in the official curriculum of one school term (≈3.5 months). Children in the control group received no intervention. The change in salt intake (measured by 24h urinary sodium) from baseline was used as the primary outcome. Secondary outcomes included the change in systolic BP and the salt reduction behaviour (SRB) score obtained via questionnaire. The SRB score was validated by the changes in 24-hour urine sodium in a random sample of 135 children.

Results: The mean baseline salt intake in children was 7.3±0.3 g/d and in adults 11.3±0.4 g/d. After intervention, salt intake decreased in the intervention group but increased in control group. The net difference of the change in salt intake between intervention and control was -0.9 g/d (95% CI: -2.6 to -1.3, P<0.0001) in children and -2.9 g/d (-3.7 to -2.2, P<0.0001) in adults. The net difference in change in systolic BP was -0.8 (-3.0 to 1.5, P=0.510) in children and -2.3 (-4.5 to -0.04, P=0.046) in adults. The intervention cost Int$19.04 per family and yielded an ICER of Int$2.74 (90% CI: 1.17–12.30) per mmHg reduction of SBP in all participants (combining children and adult participants together) compared with control group. If scaled up nationwide for 10 years and assumed deterioration in treatment effect of 50% over this period, it would reach 165 million families and estimated to avert 42,720 acute myocardial infarction deaths and 107,512 stroke deaths in China. This would represent a gain of 635,816 QALYs over 10-year time frame, translating into Int$1,358 per QALY gained. Further analysis indicated that children from families with more family members not supporting salt reduction had significantly lower SRB scores (p<0.0001). Children from a class with a smaller size and from a class with more friendship connections, as well as children having more friends within the class all showed higher SRB scores (all p<0.05). Children whose school teachers attended the intervention programme more frequently also had higher SRB scores (p=0.043).

Conclusions: The School EduSalt intervention is effective and cost-effective in lowering salt intake in families of primary school

students, which translated into significant reduction in blood pressure in adults, offering a novel approach for community prevention and control of hypertension and related disease. Family members, teachers and peers all have significant influence on the students' salt reduction behaviours.

Keywords: Salt reduction, Primary school students, blood pressure, cost-effectiveness, health education

Conflict of Interest Disclosure: Mieko Nakamura received research funding from Toyota Motor Corporation.

SY(T3)11-1

Integrated Complementary Feeding of Eggs as a Strategy to Improve Developmental Outcomes in Children at Risk of Malnutrition: The Saqmolo' Project

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Integrated nutrition interventions that address malnutrition during the complementary feeding period can help promote achievement of the U.N. Sustainable Development Goals. Inadequate micronutrient intake is associated with poor child development. Clinical interventions have suggested daily complementary feeding of chicken eggs can promote more optimal growth in Ecuadorian but not Malawian children. Effects on long-term child development also remain unclear and likely differ amongst various populations. About half of children under the age of 24-months are chronically malnourished in Guatemala. 80% of the indigenous Mayan population are food insecure and lack access to nutritious food, medical services, and education. The Saqmolo' (i.e “egg” in the Mayan language Kaqchiquel) Project is a large randomized-controlled, comparative effectiveness trial that aims to evaluate the impact of adding a single egg per day to the local standard care on child development, growth and diet quality in 1,200 rural Maya infants residing in central Guatemala (6-9 months at baseline). We will present preliminary findings (baseline) from participant children enrolled in the on-going Saqmolo' project: (i) demographic characteristics, (ii) distribution of the overall and domain specific Z-scores from the Caregiver Reported Child Development Instruments (CREDI), (iii) diet quality indicators, and (iv) anthropometric Z-scores. The team will share our experience in overcoming common challenges with implementation processes, during the COVID-19 pandemic, potential effect modifiers, and other barriers that offer perspective in assisting future development of successful nutrition intervention programs. An overview of The Saqmolo' Project Microbiome Sub-study will offer attendees a novel insight into emerging area of malnutrition research. Trial registration: NCT04316221

Keywords: Egg, child development, growth, complementary feeding, Guatemala

Conflict of Interest Disclosure: Funding for this study was provided through an unrestricted grant to the Academy of Nutrition and Dietetics Foundation via the Egg Nutrition Center.

SY(T3)11-2

The Potential of Comparative Effectiveness Trials During the Complementary Feeding Period to Enhance Child Development and Lifelong Cognition in Food Insecure Regions

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Optimizing dietary diversity and nutrition during the complementary feeding period (6- to 24-months) is critical for a child's long-term development; however, the most efficient means of achieving these goals are relatively unknown. Increasing evidence demonstrates that early childhood, within the first 1000-days post-conception, is a sensitive period of development where children cultivate foundational skills necessary to learn, interact and thrive in society. Poor growth and development are also correlated with an increased risk of infection, lifelong cognitive impairment, and fewer economic opportunities. Around the age of 6-months, an infant's need for energy and nutrients starts to exceed what is provided by breast milk, and complementary foods are necessary to help meet those needs. Although all nutrients are necessary for brain growth, authoritative groups like the American Academy of Pediatrics (AAP) consider the following nutrients as critical to support neurodevelopment during the first 1000 days: protein, zinc, iron, choline, folate, iodine, vitamins A, D, B_6, and B_{12}, and long-chain polyunsaturated fatty acids. An absence in one or more of these nutrients may result in lifelong deficits in brain function, despite subsequent repletion efforts. Prioritizing multicomponent integrated complementary feeding solutions that are economically, socially, environmentally, and nutritionally sustainable are key for the fulfilling the recent United Nations' Sustainable Development goals, which call for reducing stunting and wasting in children <5 years by 40%. Plant and animal agriculture have complementary and symbiotic roles in healthy and sustainable food systems. Animal-sourced foods are of particular interest in complementary feeding interventions to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

reduce stunting and other inadequate growth measures in early childhood, as protein quality remains a major concern in many parts of the world. Comparative effectiveness research compares two or more care options to determine which works best, for whom, and in what circumstances. It provides scientific evidence that applies to real world situations, enabling governments, policymakers and non-profits to make more informed decisions. Despite multiple factors playing a role in a child's growth and development most research to date has focused on a single intervention domain (e.g., micronutrients) versus the comparative effectiveness across multiple domains (e.g., micronutrients, food supplements, deworming medications, maternal education, and water, sanitation, and hygiene [WASH] solutions) that can be used to optimize child development.

Keywords: Egg, choline, complementary feeding, child development, Saqmolo'

Conflict of Interest Disclosure: TCW has received research funding from the Egg Nutrition Center.

SY(T3)11-3

Using Community Engagement and Implementation Research Strategies to Address Food Insecurity in Indigenous Guatemalan Communities

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Guatemala is an upper-middle income country with high prevalence of malnutrition, food insecurity and low investments in health care. Access to quality health services is further limited for vulnerable populations, i.e., rural indigenous Maya children, putting them at risk for poor health outcomes including chronic malnutrition and stunting. Therefore, programs are needed to improve nutrition-related outcomes, such as food security, development, growth, and dietary diversity. Equitable community engagement is a means of working collaboratively with governmental, private, and local community organizations and families to design and provide effective nutrition programs and services. Program implementers must think strategically and practically about how to engage communities in program planning and implementation to ensure interventions are contextually appropriate and sustainable. Wuqu' Kawoq/Maya Health Alliance (MHA) is a nonprofit health organization that offers culturally and linguistically appropriate healthcare services to rural indigenous Maya populations in Guatemala. MHA has developed an integrated local standard for nutrition care, which includes growth monitoring, deworming medication, point-of use-fortification with micronutrient powders, and complementary and responsive feeding education provided to caregivers by community health workers in their preferred language. MHA, in collaboration with the Academy of Nutrition and Dietetics, has implemented two comparative-effectiveness research projects in rural Guatemala that compare the nutrition standard of care alone to the nutrition standard of care plus other interventions: home gardens or daily eggs for infants age 6-9 months *(The Saqmolo' Study)*. In this presentation, we will discuss how both projects engaged community members and empowered families, including the formative work that was done to provide individualized and culturally acceptable interventions. Additionally, implementation and effectiveness outcomes for the home garden intervention will be discussed. The home garden intervention provided seeds and seedlings, garden construction materials, and education and support from an agronomist to families of 70 children with stunting in rural Guatemala. This study was conducted from January 2019 to July 2020 and after a 6 month intervention, compared to the standard of care alone, the garden group had better length-for-age z-score (change difference [CD] 0.22 SD, 95% CI 0.05-0.38, P= 0.009), crop species count (CD 2.97 crops, 95% CI 1.79-4.16, P<0.001), and nutritional dietary diversity (CD 0.04 points, 95% CI 0.01-0.07,P =0.006). Additionally, implementation outcomes were evaluated using the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework. This demonstrated the garden intervention had good reach, improved access to diverse foods, increased cultivation of crops by 5 species (95% confidence interval [CI], 4–6), and led to adoption of agricultural best practices. Potential barriers and considerations for sustainability include seed sourcing, access to water, and improving crop consumption. This session will offer unique insights for developing future effective and sustainable nutrition intervention programs among vulnerable populations in Guatemala and Central America.

Keywords: Guatemala, Malnutrition, Community Health, Home Gardens, Implementation Science

Conflict of Interest Disclosure: I am an employee of the Academy of Nutrition and Dietetics.

Funding Disclosures: The garden study was supported by funding from the Academy of Nutrition and Dietetics Foundation. Funding for the Saqmolo' study was provided through an unrestricted grant to the Academy of Nutrition and Dietetics Foundation via the Egg Nutrition Center.

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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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SY(T3)12-1

The role of lutein in early life

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Lutein is a non-provitamin A dietary carotenoid found in dark green leafy vegetables, corn, eggs, and avocados. Among the carotenoids, lutein and its isomer, zeaxanthin, are the only 2 that cross the blood–retina barrier to form macular pigment in the retina. Lutein also preferentially accumulates in the human brain across multiple life stages. The purpose of this presentation is to summarize the latest science on lutein's role in the eye and the brain in early life. A variety of scientific evidence supports a role for lutein status (diet, tissue levels) in vision and cognition. Lutein is not an essential nutrient and currently there are no recommendations for intakes of lutein in infants and children in this regard. However, supplementation with lutein can increase lutein in breast milk and plasma of lactating mothers taking the supplement as well as corresponding plasma lutein concentrations in their infants. Furthermore, formulas supplemented with lutein enrich this bioactive in tissues, including retina and brain, compared with infants consuming lower amounts. Therefore, higher intakes may be warranted to optimize ocular and brain development and recommendations for breastfeeding mothers may be necessary to ensure adequate lutein content in breast milk. If future intervention studies with children confirm the initial cross-sectional observations, then they may also motivate the need to improve diet in early life. Lutein intake in American adults is low (~1–2 mg/d) but it tends to be even lower in early adolescence (~300–500 μg/d) (42). As with many aspects of diet, such deficits in childhood can start a cascade that simply amplifies with age. Interventions with children likely yield lifetime benefits. Although the precise mechanisms by which lutein may be influencing neural health across the lifespan remain to be investigated, efforts may be warranted to establish recommended intakes for this dietary bioactive given the sum of the evidence to dates.

Keywords: Vision, cognition, early life, dietary carotenoids

Conflict of Interest Disclosure: None

SY(T3)12-2

Relations between carbohydrate-responsive epigenetics and DOHaD

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Many epidemiological studies suggest the environmental stresses including less of dietary nutrients during the developmental periods develop metabolic diseases in later life (DOHaD theory). One of the mechanism underlying the development of metabolic diseases in adult stages by environmental stresses is considered to be expressional changes of carbohydrate-responsive metabolic- and immune response-genes, because expression of those genes alter during development of metabolic diseases in adult stages. Recent studies demonstrated that expression of genes including carbohydrate responsive genes is regulated by epigenetic memories (histone modifications and DNA methylation) as well as by transcriptional factors. We have demonstrated that carbohydrate intake in adult stages enhances expression of metabolic- and immune response-genes, several histone modifications, which are concerned with transactivation including histone acetylation, and the histone acetylation reader bromodomain-containing protein 4 (BRD4) binding, around those genes in metabolic and immune response organs including liver, adipose and leukocytes. The transactivation related histone modifications and/or BRD4 binding, rather than transcriptional factor bindings, around the carbohydrate-responsible genes are strongly-positively associated with expression of those genes in adult stage. Furthermore, we have demonstrated that malnutrition including energy-restriction during pregnancy induces impaired glucose tolerance and/or hepatic steatosis, and enhanced expression of carbohydrate-responsive genes, and transactivation related histone modifications including histone acetylation around some of these genes, in the offspring. These results indicate that environmental stresses including less of dietary nutrients during the pregnancy develop metabolic diseases in the offspring, and one of the mechanism underlying to develop metabolic diseases in the offspring would be alteration of histone modifications around carbohydrate-responsive genes.

Keywords: Epigenetics, histone acetylation, BRD4, metabolic diseases, DOHaD

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T3)12-3

One-carbon metabolism during pregnancy and the fetal period

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One-carbon metabolism (OCM) is involved in the methionine and folate cycles, in which one-carbon units (methyl groups) are transferred during the synthesis and methylation of DNA, and during the metabolism of some amino acids. Folate is an essential nutrient for fetal development, and more than 70 countries require the fortification of staple grains with folic acid (FA) to reduce the incidence of neural tube defects. However, Japan currently does not have such a policy. An increasing number of countries with mandatory FA fortification are reporting unmetabolized FA in serum samples from their respective populations. The risk of unmetabolized FA remains unquantified, and thus the analysis of individual unknown OCM metabolites instead of "total" folate is increasing. Our research group successfully evaluated 18 intermediate metabolites involving OCM using liquid chromatography-tandem mass spectrometry (LC-MS/MS): 5-methyltetrahydrofolate (5-MTHF), homocysteine, homocysteic acid, methionine, S-adenocylmethionine (SAM), S-adenocylhomocysteine (SAH), cystathionine, cysteine, taurine, serine, glycine, choline, betaine, dimethylglycine (DMG), pyridoxamine, pyridoxine, riboflavin and unmetabolized FA. By analyzing the OCM metabolites of maternal and cord blood, we are aiming to elucidate the role of OCM during pregnancy and the fetal period.

Our study was based on the Chiba study of Mother and Child Health (C-MACH), conducted at the Center for Preventive Medical Science, Chiba University, and the Research Institute for Science and Engineering, Waseda University. Blood samples were collected during four sampling periods: maternal blood during the first and third trimester and, at delivery, and umbilical vein blood at birth.

We found that throughout pregnancy, 5-MTHF, which is a biologically active form of folate, decreased towards delivery, but was significantly higher in cord blood than in maternal serum. In contrast, FA did not change in concentration during pregnancy and in cord blood. These findings suggest that FA might be transported to the fetus in a maternal blood-dependent manner, whereas 5-MTHF might be actively transported from the mother to the fetus against gradients of concentration in the placenta. Changes in the levels of 5-MTHF were accompanied by a decrease in betaine, while a slight increase in DMG towards delivery, possibly suggesting that betaine compensates for the shortage of methyl groups from 5-MTHF to metabolize homocysteine.

Genetic polymorphisms of OCM are considered maternal risk factors for some birth defects. The most widely investigated single nucleotide polymorphism is that of methylenetetrahydrofolate reductase (MTHFR) C677T. 5-MTHF of the *MTHFR* TT genotype (minor allele homozygotes) decreased more than the *MTHFR* CC genotype (major allele homozygotes). In contrast, homocysteine increased towards delivery, and the *MTHFR* TT genotype remained higher throughout the pregnancy compared to the CT and CC genotypes.

Our current analysis did not show notable findings with methionine, SAM or SAH, which are key compounds for DNA methylation. Methionine is an amino acid, and its level might be controlled by amino acid metabolism in addition to OCM. Although the influence of OCM in epigenetics remains unclear, our recent intervention trial of long-term FA supplementation by women of childbearing age may reveal the effect of FA intake on OCM and DNA methylation.

Keywords: One-carbon metabolism, pregnancy, fetus, SNP

Conflict of Interest Disclosure: The authors declare no conflict of interest. Yoshinori Kubo and Kyoichi Oshida are the employees of Taiko Pharmaceutical Co., Ltd. However, our projects are not sponsored by them.

SY(T3)13-1

Body composition from birth to two years – narrative review summary

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Providing all infants with the best start to life is a universal but challenging goal for the global community. Historically, the size and shape of infants, quantified by anthropometry and commencing with birthweight, has been the common yardstick for physical growth and development. Anthropometry has long been considered a proxy for nutritional status during infancy when, under ideal circumstances, changes in size and shape are most rapid. Developed from data collected in the Multicentre Growth Reference Study (MGRS), World Health Organisation (WHO) child growth standards for healthy infants and children have been widely accepted and progressively adopted. In contrast, and somewhat surprisingly, much less is understood about the 'quality' of growth as reflected by body composition during infancy. Recent advances in body composition assessment have contributed to a progressive increase in our knowledge and understanding of growth and development. Using stable isotope approaches, most commonly the deuterium dilution technique, the criterion measure of total body water (TBW), we can quantify lean and fat tissue using a two-compartment model. However, until now, global reference charts for the body composition of healthy infants have been lacking. Here we detail some of the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

historical challenges associated with the assessment of body composition across the first two years of life, and sets the scene for the presentations in the Symposium, including reference charts, generated from a recent multicentre body composition initiative.

Keywords: Body composition assessment, Infants, Deuterium dilution technique

Conflict of Interest Disclosure: None

Further Collaborators: IAEA Body Composition Infant Reference Study Group

SY(T3)13-2

Infant growth and body composition from birth to 24 months: Are infants developing the same?

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Background: A healthy start to life is a universal, but challenging, aspiration for global health. Given the critical importance of the infant developmental period for establishing trajectories, our aim was to investigate longitudinal growth and body composition in six countries.

Methods: This longitudinal study followed infants from birth to 24 months-of-age in lower-middle (India, Pakistan and Sri Lanka), upper-middle (Brazil and South Africa) and high-income (Australia) countries. A total of 1152 mother-infant dyads (48.7% female infants) were recruited; 444 infants were enrolled into the sub-study using air-displacement plethysmography (ADP; total of 1781 data points) to determine body composition at birth, 1, 2, 3, 4 and 6-months of age, and 708 infants into the sub-study using the deuterium dilution technique (DD; total of 3598 data points) at 3, 6, 9, 12, 18 and 24-months of age. Mother-infant dyads were approached and screened at all sites and newborns with no health, environmental or economic constraints on growth were purposively recruited. For all infants, we measured length, weight, mid-upper arm circumference (MUAC), triceps and subscapular skinfolds, fat-free mass, and derived fat mass.

Results: The average for the pooled sample for length, weight and weight-for-length-for-age, as well as MUAC and skinfold thickness z-scores, were, as expected, approximately at the median of the WHO child growth standards given our recruitment criteria. By 24-months of age, in the pooled sample, stunting prevalence peaked at 10.3% for males and 7.8% for females with South Africa having the greater prevalence (19.7% and 14.3% for boys and girls respectively) and Brazil (2% and 3% for boys and girls, respectively). In the pooled sample, adjusting for length by deriving a Fat Mass Index (FMI; fat mass/length2) for both boys and girls, FMI increased from birth to 3-months and then remained similar across infancy. However, by 24-months, girls had greater fat mass for size (10%) than boys. For all time points, South African infants had greater FMI than Brazil, Pakistan, Sri-Lanka, with Sri-Lanka having the lowest fat mass for size.

Conclusion: In a multi-country infant population sample with optimum maternal and environmental factors, a low prevalence of undernutrition, and similar growth patterns, fat mass adjusted for length is heterogeneous across the countries. This variance may indicate that independent of growth-restricting factors, infant fat mass gain is influenced by ethnic and dietary-pattern differences, such that in some settings may contribute to early childhood obesity.

Keywords: Infants, fat mass index, body composition, growth, standards

Conflict of Interest Disclosure: None

Further Collaborators: This was a multi Centre multi - country by the IAEA Body Composition Infant Reference Study Group.

SY(T3)13-3

Body composition reference charts for infants aged birth to 24 months

Shane Norris[1], Ina Santos[3], Shabina Ariff[4], Andrew Hill[7], Rebecca Kuriyan[6], Pujitha Wickramasinghe[5], Lukhanyo Nyati[1], Nishani Lucas[5], Caroline Costa[3], Alexia Murphy-Alford[2]

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Background: Body composition assessment in the first 2 years of life provides important clinical and research insights for child nutrition and health. The application and interpretation of body composition data in infants and young children has been challenged by reference data only being available from a few high-income heterogenous samples that have not been selected to represent “optimal” growth.

Objective: To develop body composition reference charts from 0-6 months based on air displacement plethysmography (ADP) and 3-24 months based on total body water (TBW) by deuterium dilution (DD).

Method: Body composition was assessed by ADP in infants aged 0-6 months from Australia, India and South Africa. TBW using deuterium dilution was assessed for infants aged 3 to 24 months from Brazil, Pakistan, South Africa and Sri Lanka.

Reference charts and centiles were constructed for body composition using the lambda-mu-sigma method (LMS).

Results: Sex-specific reference charts were produced for fat mass (FM), fat-free mass (FFM), fat mass index (FMI), fat-free mass index (FFMI), and percent fat mass (%FM) for 0-6 months (n=468 infants; 1,899 observations) and 3-24 months (n=925 infants; 3690 observations). When compared to other available references, there were observable differences, but similar patterns in FM and FFM accretion.

Conclusion: These reference charts will strengthen the interpretation and understanding of body composition in infants across the first 24 months of life.

Keywords: Nutrition, Infant, Body composition, Growth
Conflict of Interest Disclosure: None

SY(T3)13-4

Determinants of infant growth and body composition from birth to 24 months: What are the driving factors?

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Background: The first 1000 days, from conception to 2 years of age, represent a critical window for growth and development that is central for the concept of developmental origin of chronic non-communicable diseases in the future. Growth assessment during this period has been mainly based on anthropometry. However, infants with equal weight and length may vary substantially on quality of growth. There is a need to better capture the quality of growth at early life through the assessment of body composition and to understand its driving factors.

Objective: To investigate the determinants of infant growth and body composition from birth to 24 months of age.

Method: This was a multicenter, prospective, observational study, with data from two cohorts: the 0-6-month cohort (Australia, India and South Africa) and the 3-24-month cohort (Brazil, Pakistan, South Africa, and Sri Lanka), which enrolled 468 and 925 newborns, respectively. Anthropometry measurements followed the World Health Organization Multicentre Growth Reference Study protocol. At the 0-6-month cohort, body composition was assessed by air-displacement plethysmography within 2-3 days of birth, 2 weeks, 1, 2, 3, 4, and 6 months. At the 3-24-month cohort, body composition was assessed by the Deuterium Dilution method at 3, 6, 9, 12, 18, and 24 months. For both cohorts, weight-for-age (WAZ), length-for-age (LAZ) and weight-for-length (WLZ) z-scores, fat mass (FM), fat free mass (FFM), FM index (FMI), and FFM index (FFMI) were calculated. Independent variables comprised the Gini index of the country, maternal and child characteristics at birth, and breastfeeding pattern at 3 months. For the 3-24-month cohort, information on breastfeeding and minimum dietary diversity at the 12-month was also included. Crude and adjusted beta coefficients (with 95%CI) were calculated by multilevel modelling using mixed effect models.

Results: At 6 and 24 months a total of 231 and 490 children, respectively, from the 0-6-month cohort and the 3-24-month cohort were analyzed. At 6 months, boys were on average 450 grams heavier and had 460 grams more of FFM than girls; at 24 months, boys had on average 380 grams more in FFM than girls, while all other nutrition indices were similar between sexes. Birth weight was the strongest and most consistent positive predictor of anthropometric and body composition indices at 6 (WAZ, FFM) and 24 months (WAZ, LAZ, WLZ, FFM, and FFMI), irrespective of sex. In girls birth weight was also positively related to LAZ and FFMI at 6 months, and to FM at 24 months. On the other hand, exclusive breastfeeding at 3 months and continued breastfeeding at 12 months were the strongest and most consistent negative predictors of body composition indices, respectively at 6 and 24 months, independently of sex. At 6 months, exclusively breastfed boys and girls at 3 months had lower FFMI, and at 24 months those breastfed at 12 months presented lower FM, FFM and FFMI (FMI was lower in boys only).

Conclusion: Birth weight and breastfeeding are independent predictors of body composition in early life, irrespective of sex.

Keywords: Body composition, Anthropometry, Birth weight, Breastfeeding, Children

SY(T3)13-5

Body composition of infants at 6 months of age using the 3-compartment model

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Background: Early life body composition plays an important role in programming later life health outcomes. The commonly used 2-compartment (2C) model assumes that the composition of fat-free mass (FFM) remains constant, which may not be accurate in infants during periods of rapid growth and maturation. The 3-compartment (3C) model based on measurements of hydrometry, and densitometry overcomes some of the uncertainties concerning the hydration of FFM. There is paucity of data with regard to the hydration and density of FFM in infants from different countries/ethnicities.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Objective: The objectives of the present study were (1) to determine the body composition of infants at 6 months of age from 3 countries (Australia, India and South Africa) using the 3C model, (2) to compare the estimates of body composition obtained from Air Displacement Plethysmography (ADP) and Deuterium Dilution (DD), (3) to compare the biological variation in the density and hydration of FFM between the three countries.

Method: Anthropometry and body composition were measured at 6 months of age in 176 healthy infants (46 from Australia; 86 from India and 44 from South Africa) using ADP (PEA POD, Software version 3.5.0, 201, COSMED, USA) and DD using standard protocols, from which 3C model estimates were calculated. Details on maternal characteristics and feeding history of the infants were recorded using questionnaires. Bland Altman and correlation analyses were carried out to compare the estimates of ADP with DD. The density and hydration of FFM were determined and compared between the infants of the different countries using one way ANOVA.

Results: The mean body weight and length of the infants was 7.2 ± 0.8 kg and 65.5 ± 2.5 cm. Girls comprised 52% of the group. The pooled estimates of % fat mass (FM) was 27.2 ± 5.0%, while % FFM was 72.8 ± 5.0% from the 3C model; infants from South Africa had significantly higher % FM in comparison to Australia and India. The mean difference (bias) between estimates of % FM obtained from ADP and DD was -0.66%, [95% CI; -8.9-7.6%] and correlation was r = 0.83 (p<0.01). The hydration factor of FFM in infants was 0.796 ± 0.015, 0.796 ± 0.023, and 0.785 ± 0.020 in Australia, India and South Africa, respectively; Australian infants had significantly higher hydration in comparison to South Africa (p<0.05), while the density of FFM in South African infants (1.071 ± 0.008 g/mL) was significantly higher when compared to Australian (1.067 ± 0.006 g/mL) and Indian infants (1.067 ± 0.009 g/mL).

Conclusion: The % FM estimates from 3C model suggests that South African infants may have higher % FM. The estimates of % FM from ADP and DD correlated well and had a relatively low bias. Biological variability seems to exist in the hydration and density of FFM in the infants from the three countries. Our findings suggest the need to revisit assumed constant values for infants, particularly regarding FFM composition, which would have important implications for the different 2C methods that are widely used in infant research.

Keywords: Body composition, Infants, Air displacement plethysmography, Deuterium dilution, 3C model

Conflict of Interest Disclosure: None

SY(T3)13-6

Anthropometric indicators of body composition from birth to 24 months

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Background: Early life body composition plays an important role in programming later life health outcomes. The commonly used 2-compartment (2C) model assumes that the composition of fat-free mass (FFM) remains constant, which may not be accurate in infants during periods of rapid growth and maturation. The 3-compartment (3C) model based on measurements of hydrometry, and densitometry overcomes some of the uncertainties concerning the hydration of FFM. There is paucity of data with regard to the hydration and density of FFM in infants from different countries/ethnicities. Assessment of growth during the rapid growth period has gained importance with the increase in incidence of childhood obesity as well as understanding the impact of early growth on health throughout life. However, most of the currently available body composition methods are not suitable for field or clinical practice. This multicenter study attempts to develop an anthropometry-based technique to estimate body composition of 3–24-month-old infants.

Method: A multicenter longitudinal body composition study involving infants from Brazil, Pakistan, South Africa, and Sri Lanka was carried out with the assessment of body composition using the two-compartment model. Fat free mass (FFM) was assessed using deuterium dilution (DD) technique and fat mass (FM) was derived by subtracting FFM from body weight. Anthropometric measurements were taken at 3, 6, 12, 18, and 24 months. The study sample consisted of 1896(942 girls) training observations which were used to develop the model, 941(441 girls) validation observations for internal validation of the model and 349(185 girls) test observations for external validation. The test group consisting of 3–6-month-old infants from South Africa, Australia, and India where data were collected independent to the longitudinal study group. Distribution of all variables were assessed using scatterplots and Pearson correlations. A linear mixed model on the training data separately for girls and boys was used to develop equations to predict FM and FFM. Models were tested on validation data and the quality of predictions were assessed using: (a) error metrics (root mean squared error-RMSE), root mean squared percentage error (RMSPE), mean absolute error (MAE), mean absolute percentage error (MAPE) values, and (b) the number of true values outside the prediction interval.

Results: Length and weight adjusted for covariates were positively associated with FM and FFM in both sexes. Skinfolds were positively associated with FM. A linear mixed model was

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

fitted on training data separately for girls and boys to develop the prediction equations for FM (kg) and FFM (kg). The model was adjusted for length (cm), weight-for-height (kg/cm), triceps and subscapular skinfold thicknesses (cm), and Asian ethnicity. Head circumference and arm circumference did not affect the model outcome. Equations were developed to predict FM and FFM for each sex for three age categories (3-9 mo; 10-18mo; 19-24mo). RMSE was higher for FM and FFM among older children in both males and females. RMSE was also similar between validation and test data. Majority of observations were within the prediction intervals. RMSPE and MAPE were higher for validation data while predicting FM in males and females, compared to test data, but both were higher in test data for predicting FFM. RMSPE was very high for prediction of FM but was quite low (approximately 10%) for predicting FFM. MAE was about 500g for assessment of both FM and FFM in all three groups, but the MAPE was low (under 10%) for assessment of FFM in all three groups.

Conclusion: Anthropometry based prediction equations to assess FFM provides acceptable results in this multi-ethnic cohort of children for field use.

Keywords: Infant body composition, Anthropometry based, fat mass, fat free mass, Asian ethnicity

Conflict of Interest Disclosure: None

SY(T3)14-1

Using implementation research to improve programs targeting adolescents– experiences from Indonesia and Bangladesh

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Adolescents are increasingly becoming important 'agents of change' who actively reshape their social environments and even spearhead global movements for change. Programmes that aim to improve adolescents' diet quality should actively involve them and leverage their agency to become drivers of change towards improved diets. The aim of this session is to present and discuss the learning from implementation research conducted to assess two initiatives designed to engage adolescents in making better food choices - the *Bhalo Khabo Bhalo Thakbo* ("Eat Well, Live Well" in Bengali) and *Saya Pemberani* ("I'm Courageous" in Indonesian) campaigns in Bangladesh and Indonesia, respectively.

The Bhalo Khabo Bhalo Thakbo campaign was implemented nationwide by the Global Alliance for Improved Nutrition (GAIN) and partners between 2019 and 2021. The campaign combined social media (including promotional videos by celebrities and influencers), in-person components (such as school events), use of traditional media (radio show), for promoting improved food choices, including a pledge by adolescents to change their food habits. A research consortium led by the Institute of Development Studies (UK) conducted an external evaluation of the campaign. The evaluation adopted a theory-based mixed methods approach using contribution analysis. The evaluation included an observational quantitative design (with a baseline and endline survey and with ex post assignment of treatment status based on the observed level of intensity of exposure to the campaign), in-depth interviews, stakeholder interviews and an online survey.

Using the social entrepreneurship approach, Saya Pemberani aimed to engage young people living in urban areas in articulating solutions to contextual problems that preclude healthy diets. Teaming up with Ashoka, a non-profit organisation that fosters social entrepreneurship, GAIN designed and implemented the programme between April 2019 and June 2020 in the city of Surabaya and the Jember district in East Java, Indonesia. An independent process evaluation was conducted by Reconstra between March and December 2020. The study aimed to assess Saya Pemberani's reach (to what extent the programme reached its intended audience), fidelity (to what extent the programme components were implemented as intended) and the participants' satisfaction (how the participants characterised their engagement with Saya Pemberani). Results from both countries revealed the importance of building flexible and adaptable programs that respond to the dynamic nature and changing realities and context of adolescents, using multiple platforms to reach adolescents, engaging other influential actors in adolescents' life such as parents, teachers, and peers, and recognizing the particular characteristics and needs of the different adolescent subgroups (younger vs older adolescents, rural vs urban, etc.).

Both campaigns failed to engage adolescents of lower socioeconomic status, which highlights the need for purposively designing more inclusive programs. In Bangladesh, the campaign sparked interest for improving their consumption of nutritious foods; however, as compared to non-intervention groups, adolescents exposed to the campaign did not show a significant change in willingness to purchase more nutritious foods. Qualitative findings suggest that the COVID-19 pandemic heightened adolescents' interest in healthy eating, which might help explain the campaign's lack of impact on purchase and consumption of more nutritious foods. In conclusion, implementation research identified key elements that should be considered for designing, implementing, and evaluating adolescent programs.

Keywords: Adolescent nutrition, Adolescent programming, implementation research, food choices

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T3)14-2

Building adolescent self-efficacy, health and resilience: lessons from Nepal and Bangladesh

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Adolescents ages 10-19 make up about one-quarter of the population of Nepal and of Chittagong Hill Tracts (CHT) of Bangladesh. Girls in both settings are less likely to attend secondary school, more likely to marry and begin childbearing, and have suboptimal dietary diversity. In Nepal 27% of girls marry before age 19, while in CHT 54% of women aged 20-24 were married before age 18. As a consequence, young girls face narrowing access to information and life choices.

To inform design of programs to counteract these trends, formative research was conducted with n=840 girls ages 10-19 via a survey panel in Nepal and with n=52 girls and n=52 boys ages 12-17 in CHT via focus group discussions exploring aspirations and their determinants. Despite their challenging circumstances, in both settings adolescents' educational and occupational aspirations are high. In Nepal 58.6% wish to study beyond grade 12 and 75% to pursue occupations requiring professional or higher formal education. Adolescents from all ethnicities in CHT wish to complete their education and be financially self-sufficient. They also aspire to be a good person, mother, member of society and respected. In Nepal girls on average wish to defer marriage until age 22 and childbearing to age 24, while in CHT they perceive early marriage to be linked to poverty and poor physical and mental health. Among Nepali youth, higher aspirations are positively associated with higher self-efficacy scores, especially among younger adolescents (ages 10-14), caste and wealth, and in CHT aspirations are more limited where parents do not support their children's education and career goals.

Building on these findings, the USAID-funded Suaahara II project in Nepal targeted younger, in-school adolescents with an integrated package of materials for use by teachers and resource students covering nutrition and health, hand and menstrual hygiene, delaying marriage, continuing education, and building student self-confidence, self-efficacy, and leadership skills. They content was pre-tested and adjusted with feedback. Resource students set a goal of sharing themes with at least 5 peers, either in school, through specially designed *sathi* (friend) resource corners, or after school. Concepts were further reinforced through integration in the popular national radio program "Chatting with my best friend". In Bangladesh, the USAID-funded Sapling project developed a suite of strategies to build confidence and leadership skills in youth and strengthen community cohesion. Community-based girls empowerment groups aimed to build problem-solving and critical thinking skills, self-esteem and confidence, health and life skills and reproductive health and nutrition knowledge. Young boys and girls were trained to become "little doctors" or health and hygiene champions in their schools and communities. Older adolescents were trained in natural resource management techniques to become "forest management brigades" or in first aid, search and rescue and disaster risk management to become "Red Crescent youth". Altogether about 22,600 young people participated in these opportunities, building self-confidence and contributing to their communities. More outcomes forthcoming.

Keywords: Adolescence, Self-efficacy, Aspirations, Integrated programming, Nutrition

SY(T3)14-3

Enabling improvements in adolescent nutrition through youth inclusive and gender responsive programs at scale

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Background & Objectives: Through the Right Start initiative from 2015-2019, Nutrition International supported national governments were supported to initiate Adolescent Nutrition programs in six countries across Africa and Asia and the existing program was strengthened in 5 Indian states, with the goals of reducing anaemia for adolescent girls through WIFAS and nutrition education. From 2020 there is an additional focus of increasing adolescents' understanding of their own growth, development, and nutritional needs.

Methods: National governments were supported in developing, updating, and adapting guidelines for adolescent nutrition. Demonstration projects enabled testing of optimal delivery platforms for in and out-of-school girls that could be expanded to additional geographies, then scaled up. Key aspects of each program were formative research for behaviour change interventions; training of teachers and health providers; nutrition curriculum development and revision; strengthening WIFAS supply and logistics; establishing monitoring and reporting systems across sectors; advocacy and policy review; and fostering multisectoral collaboration. Youth were engaged in formative research; creating Behaviour change strategies; youth nutrition and health clubs; delivering and reporting on WIFAS consumption; and in identifying gendered barriers to equitable participation.

Results: A total of 195k intermediaries were trained on adolescent nutrition and anaemia across multiple sectors, including teachers, frontline health workers, managers, and key policy makers and programmers. Government programs were established and reached an additional 10 million adolescent girls with WIFAS and 6.6 million adolescent girls and boys with nutrition education. An estimated 1.2 million cases of anaemia were averted. Out of school adolescent girls were among the most vulnerable and delivery of nutrition interventions to those out of school was more resource intensive during the Right Start

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DOI: 10.1159/000530786

project (2015-2019). With COVID-19 related closures from 2020-2022 school-based delivery was limited and programmers were challenged to adapt.

Conclusions: Adolescent nutrition gained priority in global and national agendas and multi-sectoral programs. School-based anaemia reduction programs demonstrated the potential to improve well being for adolescents. Vulnerable adolescent girls face gender inequities and will benefit from increased youth responsiveness of health and education systems. Youth participation is key to strengthening these systems and adolescent nutrition programs to be more resilient and equitable.

Conflict of Interest Disclosure: We have no conflicts of interest to declare.

Keywords: Adolescent Nutrition, Anaemia, Weekly Iron Folic Acid Supplementation, Youth Engagement, Gender Equality

SY(T3)14-4

Approaches to reach and engage adolescents and adolescent mothers in Africa and Asia

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Background and objectives: Reaching and engaging adolescents (girls and boys) before and when they conceive a child and become parents is key to breaking the inter-generational cycle of malnutrition. The needs, challenges and aspirations adolescents face vary widely by context and so must the approaches and solutions to address them. Save the Children is currently implementing nutrition programmes in 40 countries globally reaching nearly 12 million children (including adolescents). This presentation will discuss the very different issues adolescents face in each context and the range of approaches used to reach and actively engage adolescent girls, boys, schools, family and community members in addressing these issues.

Methods: The presentation will draw on 1) formative research findings, including from Immersion Research, Reality Check Approach (RCA) and People-Centred Design studies conducted in Indonesia and Malawi; 2) Programme examples from 2-3 countries in Asia and Africa on approaches used to reach and engage adolescents to improve their own health and nutrition, delay pregnancy (where early pregnancy is common), and receive appropriate care and support when they become pregnant, mothers and fathers themselves.

Results: In rural Malawi, adolescent marriage and pregnancy is common and viewed as normal after leaving primary school; poverty, food insecurity, poor diets (staple-maize based with little vegetable or animal-based foods); low access to nutrition services (iron supplements) and frequent disease (malaria, diarrhoea) are some of the main drivers of undernutrition and anaemia amongst adolescent girls. In Indonesia (NTT and West Java), while adolescent marriage and pregnancy are less common, poverty and food insecurity less acute, adolescent diets are still primarily rice based, supplemented by fried, sweetened, and packaged foods, with low nutrient content, coupled with low adherence to school iron supplementation programmes. In both countries, a people centred design process was used to identify small doable actions which adolescents can do and promote themselves through school, youth groups or adolescent mother groups. These adolescent-led "solutions" will be presented alongside other examples from community and school-based programmes.

Conclusion: The challenges, needs and aspirations of adolescents, girls and boys, before and after they become parents vary widely by and within each context. They cannot be treated as one homogenous "beneficiary" group but instead need to be engaged and become the main actors in finding their own solutions to problems they recognise as important. This presentation draws on Save the Children and its partners (Empatika, Nutrition International and others) experience in Asia and Africa, engaging adolescents to improve their own and their children's health, nutrition and in doing so, help break the intergenerational cycle of malnutrition.

Keywords: Adolescent Nutrition, Behaviour Change, Diet Diversity, Malawi, Indonesia

Conflict of Interest Disclosure: None

Further Collaborators: Power of Nutrition

SY(T4)1-1

Overview: Specific nutritional status and involvement in health problems in older people

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Body composition changes with age. In general, older people have less muscle mass and more fat, especially visceral fat mass, than middle-aged adults. Age-related changes in muscle mass cause sarcopenia and frailty, which are the themes of this symposium. In addition, the height decreases with aging, and the body mass index (BMI) increases even if they maintain their middle-aged weight. In addition, the weight itself often gradually decreases in older old.

Good nutritional status is crucial for maintaining growth and health in all stages of life. However, the relationship between nutritional status and health and the effect on various health-related outcomes differ, depending on the life stage. Many adverse outcomes in older adults, directly linked to different nutritional status, are not present in middle-aged adults, and their ideal nutritional status may differ. In fact, it is possible that

the optimal nutritional status for poor health outcomes such as mortality and physical dysfunction related to healthy life expectancy in the older adults is different from that in middle-aged adults.

Presence of metabolic syndrome is already established as a risk factor associated with all-cause and cardiovascular deaths in middle-aged adults, but the impact of metabolic syndrome on the life prognosis in the older adults is clearly reduced compared to middle-aged adults. The adverse health effects of obesity in middle age are also mitigated in the older people, especially in the older old. In fact, regardless of race, the hazard ratios of all-cause mortality for overweight and obesity were lower in older ages than in younger ages.

However, on the contrary, the problems of weight loss and undernutrition are highlighted in the older people. Weight loss and undernutrition cause physical frailty and sarcopenia, and pose a risk of various new illnesses, physical dysfunction, and death in older people. It should be noted that the main nutritional targets of middle-aged adults and the older old thus face the opposite problems (overnutrition and undernutrition). Therefore, it is extremely important for nutritional guidance by medical personnel to take into consideration the age of the subject.

Keywords: Nutrition, Older people, Malnutrition, Sarcopenia, Frailty

SY(T4)1-2

Home-based exercise and nutrition interventions for frailty

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Frailty is a geriatric syndrome characterized by declined physiological reserves and resistance to stressor events that can increase the risks of adverse health outcomes, such as functional disability, hospitalization, and death. Therefore, the prevention and management of frailty is of great importance for both clinicians and elders. The objective of this study was to develop individualized home-based exercise and nutrition interventions for improvement of frailty in the elderly. In this talk, I would like to report to you a study with a four-arm, single-blind, randomized controlled trial, which was conducted at the Miaoli General Hospital in Taiwan. Participants were randomly assigned into one of four study groups for 3-month intervention and 3-month self-maintenance period: control; exercise; nutrition; combination (exercise plus nutrition) group. The frailty phenotypes were quantified by frailty score, which was the primary outcome in this study. A total of 1,160 elderly were invited to participate this study, from whom there were 319 eligible subjects who coincided with the selection criteria. At 6 months, compared to the control group, the exercise (points: -0.23; 95% confidence interval [CI]: -0.41, -0.05; $p < 0.05$), nutrition (points: -0.28; 95% CI: -0.46, -0.11; $p < 0.01$), and combination (points: -0.34; 95% CI: -0.52, -0.16; $p < 0.001$) groups revealed significant improvement in frailty score change from baseline. Significant improvements also observed in handgrip strength, 10 m gait speed, back scratch, sit and reach, and lower extremity strength in the exercise, nutrition or combination groups, improvement of short form-12 mental component summary score in the nutrition group. The results revealed that individualized home-based exercise and nutrition interventions can help to improve frailty score and physical performances for the elderly with pre-frailty or frailty. In addition, the combination intervention has synergistic effects.

Keywords: Frailty, Older adults, Exercise, Nutrition, home-based frailty interventions

SY(T4)1-3

Combined exercise and nutritional intervention for sarcopenia and frailty

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Frailty is a state of increased vulnerability to various stressors and increased risk of adverse health outcomes, such as loss of independence and death. Frailty is not an irreversible aging process but a reversible state with appropriate interventions (The Japan Geriatrics Society, 2014). Although the prevalence of frailty varies by definition, a systematic review of studies on the Japanese population reported it to be 7.4% (Kojima et al., *J Epidemiol*, 2017). A recent national survey reported a prevalence of 8.7% (Murayama et al., *Arch Gerontol Geriatr*, 2020). Based on Fried's physical phenotype model (Fried et al., *J Gerontol A Biol Sci Med Sci*, 2001), a representative conceptual model of frailty, physical frailty characterizes slowness (slow walking speed), weakness (low strength), weight loss, exhaustion, and low physical activity. Sarcopenia, which shares some diagnostic criteria with the physical phenotype models described above, refers to the age-related loss of muscle mass and muscle strength and function (Chen et al., *J Am Med Dir Assoc*, 2020). In October 2016, sarcopenia was coded as per the International Classification of Diseases, 10th edition and officially recognized as a disease. As frailty and sarcopenia are overlapping concepts, their underlying treatment strategies are similar. The Asia-Pacific Clinical Practice Guideline for the Management of Frailty (Dent et al., *J Am Med Dir Assoc*, 2017) and The ICFSR International Clinical Practice Guidelines for the Identification and Management (Dent et al., *J Nutr Health Aging*, 2019) gave a "strong recommendation" for a multicomponent exercise program (including resistance-based training) as the first-choice option for improving frailty. In addition, an increase in energy and protein intake is conditionally recommended, especially for older adults with weight loss or malnutrition. Furthermore, a conditional recommendation is also given for a combined exercise and nutritional intervention. A systematic review also

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

reported that combined resistance exercise and nutrition are particularly effective in treating sarcopenia (Yoshimura et al., *J Am Med Dir Assoc*, 2017). Which nutritional supplementation strategies effectively improve frailty and sarcopenia? Over the past 10 years, the authors' research group has conducted exercise and nutritional intervention studies in older adults with frailty and sarcopenia. In particular, we have investigated the effects of resistance exercise combined with essential amino acids (Kim et al., *J Am Geriatr Soc*, 2012), tea catechins (Kim et al., *Geriatr Gerontol Int*, 2013), milk-fat globule membrane (Kim et al., *Plos One*, 2015), and β-hydroxy-β-methyl-butyrate (Osuka et al., *Am J Clin Nutr*, 2021) using randomized controlled trials. Thus, our talk provides an overview of these studies and discussions for future directions.

Keywords: Resistance training, Milk fat globule membrane, β-hydroxy-β-methylbutyrate, Essential amino acids, Tea catechins

SY(T4)1-4

Nutritional strategy for sarcopenic dysphagia

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Sarcopenia, a decrease in skeletal-muscle mass and function, is an important disease with regard to geriatric nutrition. Interest in sarcopenic dysphagia, which is defined as swallowing difficulty caused by decreased muscle mass and function in eating-related muscles, is growing. In 2019, four Japanese academic societies published a position paper that focused on the concept, definition, and diagnosis of sarcopenic dysphagia. The proposed diagnostic criteria for sarcopenic dysphagia include the presence of generalized sarcopenia, low tongue strength, and dysphagia with no obvious cause such as stroke or neurodegenerative disease. The prevalence of sarcopenic dysphagia has been reported to range from 13% to 42% in hospitalized elderly patients and 32% in hospitalized patients undergoing dysphagia rehabilitation. The known risk factors for the development of sarcopenic dysphagia include poor physical function, malnutrition, and severe sarcopenia. Physical and nutritional interventions are expected to improve the strength of the muscles of deglutition. We recently reported that physical and nutritional interventions improved tongue strength in older adults in a rehabilitation hospital. Tongue strength increased with higher energy and protein intake and during regular physical and occupational therapy without swallowing training. These results suggest that the treatment of dysphagia in sarcopenia requires physical intervention with nutritional supplementation, in addition to swallowing training. Another study in a rehabilitation hospital found that aggressive nutritional therapy contributed to improved swallowing function in patients with sarcopenic dysphagia. The group with a mean energy intake ≧30 kcal/kg/day had significantly higher rates of achieving clinically important differences in swallowing function and activities of daily living at discharge. Proactive nutritional care for sarcopenic dysphagia appears to be crucial, in addition to traditional swallowing training.

Keywords: Sarcopenia, Rehabilitation, Nutritional care, Swallowing training

Conflict of Interest Disclosure: None

SY(T4)2-1

Effect of Carbohydrate-restricted Diets and Intermittent Fasting on Type 2 Diabetes Management

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Carbohydrate-restricted diets and intermittent fasting (IF) have been rapidly gaining interest among the general population and patients with cardiometabolic disease, such as overweight or obesity, diabetes. However, there are limited expert recommendations for these dietary regimens. This study aimed to evaluate the level of scientific evidence on the benefits and harms of carbohydrate-restricted diets and IF to make responsible recommendations. A meta-analysis and systematic literature review of 66 articles on 50 randomized controlled clinical trials (RCTs) of carbohydrate-restricted diets and ten articles on eight RCTs of IF was performed. Based on the analysis, the following recommendations are suggested. In adults with type 2 diabetes, a moderately-low carbohydrate or low carbohydrate diet can be considered as a dietary regimen for improving glycemic control and reducing body weight. In contrast, a very-low carbohydrate diet and IF are not recommended in patients with diabetes.

Keywords: Diabetes Mellitus, Diet, Carbohydrate

Conflict of Interest Disclosure: no COI

SY(T4)2-2

Dietary guidelines and management status of Korean Diabetes

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In East Asia, the number of adults with diabetes had the largest absolute rise, 106 million in 2014 compared to 1980, based on the NCD Risk Factor Collaboration 2016 report. Since dietary intervention plays a pivotal role in maintaining good glycemic control for diabetes, dietary guidelines reflecting ethnic

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

traits have been developed and recommended. In South Korea, the prevalence of diabetes increased moderately from 2007 to 2017. Nutrition therapy plays a key role in the management of diabetes. I will briefly introduce dietary guidelines of Koreans and medical nutrition therapy (MNT) by the Korean Diabetes Association. I will present the differences in health behaviors and nutrient intake status among aware and unaware Korean adults with diabetes using Korea National Health and Nutrition Examination Survey data. I will also discuss the adherence to MNT guidelines based on diabetes awareness among Korean adults and nutrition education and treatment in the diabetes-aware group. This national level data analysis provides useful insights into Korea's approach to diabetes management.

Keywords: Korean diabetes, medical nutrition therapy, nutrient intake, adherence to dietary guideline, awareness

SY(T4)2-3

Nutrition therapy for diabetes in Japan

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Optimal dietary therapy for diabetic patients is to implement diet therapy that has an appropriate amount of energy, is well-balanced in nutrition, and implements regular diets to suppress the onset or progression of complications. In Diabetes Clinical Practice Guidelines 2019, it was decided that the appropriate amount of energy should be determined by setting a target weight and multiplying it by an energy factor based on the physical activity level and pathology. On the other hand, the number of obesity cases is increasing, and postprandial hyperglycemia and blood sugar spikes increase the risk of vascular and organ damage, so dietary habits are also important. Ingestion of dietary fiber mainly derived from grains leads to the prevention of diabetes, and it is thought that there are many merits in ingesting water-soluble dietary fiber in particular. Eating in the morning has many benefits, such as suppressing obesity, improving blood sugar levels, and increasing muscle. The "Food Exchange Table for Diabetic Diet" ("Food Exchange Table") is a diet bible created from the perspective of what a diabetic diet is and what kind of foods should be taken. If you make a meal plan according to the "Food Exchange Table" and choose ingredients that contain different nutrients in just the right amount, you will be able to take in the amount of energy and nutrients that are suitable for treatment. It has been reported that the elderly have a low muscle synthesis rate and diabetes leads to a decrease in muscle mass, so it is important for elderly diabetic patients to take in sufficient protein. To prevent frailty and sarcopenia in the elderly, adequate protein intake is necessary unless severe renal impairment is present. To maintain muscle mass in the elderly, it is recommended to consume at least 1.0 g/kg body weight/day of protein. It is important to actively ingest leucine-rich white meat. It has also been reported that if the protein distribution is even at three meals (30 g breakfast, 30 g lunch, and 30 g dinner), the muscle protein synthesis reaction will be higher for 24 hours than if the protein intake is skew (10 g breakfast, 15 g lunch, and 65 g dinner). Dietary fiber, especially water-soluble dietary fiber and miso, may not only improve postprandial hyperglycemia but also increase muscle mass through the production of intestinal metabolites. A feature of Japanese food is that it is based on rice (carbohydrate), which is the "staple food", plus "main dishes" such as seafood and soybean products, and "side dishes" such as seaweed, root vegetables, mushrooms and beans. We believe that it is important to practice an appropriate diet for the prevention and treatment of diseases. Moreover, in order to enable long-term continuation, it is necessary to consider not only safety but also Japanese food culture and patient preferences.

Keywords: diabetes, complication, sarcopenia, fiber
Conflict of Interest Disclosure: None
Further Collaborators: None

SY(T4)2-4

Nutrition Therapy for Diabetes:

Clinical Guidelines, Clinical Trials and Clinical Practice

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Nutrition therapy can have a profound effect on diabetes outcomes, improving glycemic control, blood lipid levels, weight, and quality of life, and reducing hypoglycemic events and medications. A low-carbohydrate nutritional approach that reduces intake of starch and sugar has been used successfully to improve all of these outcomes. In this presentation, the composition and underlying physiology behind low-carbohydrate diets will be described. The effects of low-carbohydrate nutrition on diabetes outcomes in clinical trials will be explained and examples from clinical experience will be illustrated. Finally, findings from and how a low-carbohydrate eating plan fits in the context of the American Diabetes Association's consensus report on nutrition therapy will be reported.

Keywords: Nutrition, Type 2 diabetes, Low-carbohydrate diet, Glycemic control, Guidelines
Conflict of Interest Disclosure: None
Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T4)3-1

The many faces of food allergy

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Food allergy is a common disorder affecting up to 5% of the population and it is usually more common in children. The manifestations vary widely from a simple itch of the skin or around the mouth to potentially fatal anaphylatic reaction affecting the cardiovascular and respiratory systems. Many factors may affect the manifestations of food allergies. These include the type of food allergens, the preparation of the food allergens, the dosages, the route of entry into the body, the age of the patients, and other cofactors such as exercise, use of drugs, or menstruation. The most common manifestations of food allergy include itchy skin rash, tingling and itching of the mouth or around the mouth, swelling of the face, lips, or the throat resulting in swallowing problems, difficulty of breathing, nausea, vomiting, diarrhoea, itchy and watery eyes. The most severe form is called anaphylaxis which is usually associated with breathing troubles, fainting and sudden collapse. The timing of developing these symptoms may vary. However, IgE medicated food allergy usually results in manifestation within 2 hours of ingestion of the allergen. Non IgE mediated food allergy is less common but can also be very severe especially in young infants. Exercise- induced food allergy is a very special form that the subject will develop symptoms only if ingestion is followed by exercise. Therefore, a careful history is needed to tease out what could be the potential culprit causing the symptoms. Testing such as measurements of IgE or skin test must be interpreted in light of the history. Otherwise, excessive and unnecessary dietary restrictions will result in more harm to the subjects especially in children.

Keywords: food allergy, Symptoms, epidemiology
Conflict of Interest Disclosure: None
Further Collaborators: None

SY(T4)3-2

Food allergy management in Japan

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Food allergies in Japan are generally classified into four clinical types: (1) neonatal and infantile gastrointestinal allergy, (2) infantile atopic dermatitis associated with food allergy, (3) immediate-type of food allergy (urticaria, anaphylaxis, etc.), and (4) special forms of immediate-type of food allergy such as food dependent exercise-induced anaphylaxis (FDEIA) and oral allergy syndrome (OAS). Most common food allergy is the immediate-type of food allergy that is seen from childhood to adulthood. Infantile atopic dermatitis associated with food allergy type is especially important as the onset of most food allergies occurs during infancy. Most frequent causative foods during infancy were hen's egg, cow's milk, and wheat. Recently, tree nuts allergies, especially walnut and cashew are increasing trend in Japan. FDEIA are mostly seen in school age children to adolescence, most common causative foods are wheat, shrimp and fruits. OAS is almost identical to pollen-food allergy syndrome (PFAS), and cross reactivity between pollen and fruits such as PR-10 family and profilin is the cause of PFAS. Detailed history taking on food allergy and dietary life by both doctors and registered dietitians are the most important diagnostic procedures. Diagnosis accuracy using antigen-specific IgE is recently improved by the application of probability curves and component-resolved diagnosis (CRD). CRDs for hen's egg (ovomucoid), peanut (Ara h 2), walnut (Jug r 1), and cashew (Ana o 3) are approved by the nationwide insurance and widely used as a routine diagnostic procedure. Oral food challenge (OFC) using a stepwise approach (low dose, medium dose and full dose) is recommended to avoid complete elimination of causative foods in our guidelines. Although avoidance is the gold standard of management of food allergy in the rest of the world, recommendation of partial intake proved by OFC is quite unique approach. Systematic reviews of domestic reports on OFC for hen's egg and cow's milk were performed and to prove the efficacy and adverse events. After stepwise OFC dietary advice and guidance by registered dietitians are also recommended. Although oral immunotherapy (OIT) has not been approved as a routine treatment by nationwide insurance, OITs against hen's egg, cow's milk, wheat and peanut are widely performed in Japan as research procedure. Prevention of food allergy is currently the focus of interest, and many changes were made based on recent evidence. Finally, team practice including allergy specialists and registered dietitians play a very important role for the management of food allergy.

Keywords: food allergy, IgE, oral food challenge
Conflict of Interest Disclosure: Scientific advisary board: Novartis, Sanofi, Mylan, and ARS-Pharmaceuticals

SY(T4)3-3

Nutritional guidance in food allergy

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Patients with food allergies have to eliminate specific foods from their diet, which imposes a heavy burden on their eating habits, such as narrowing their range of food choices. Therefore, it is necessary for a dietitian to support the dietary habits of such patients through nutritional guidance, so that their quality of life stemming from their dietary habits can be improved as much as possible. Nutritional guidance includes the following major points: First, patients with food allergies must eliminate the

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DOI: 10.1159/000530786

minimum kind and amount of food from their diet. In other words, it is important for patients to accurately understand what they can and cannot eat. It is necessary for them to learn the characteristics of the food allergen, which foods must be eliminated, and how to read food labels. For example, in the case of hen's egg allergy, the patient should know about the characteristics of hen's egg allergens, the types of processed foods that need to be eliminated and those that can be eaten, and how these allergens are labeled as a raw material in processed foods. Second, patients must learn how to ensure their own safety. They must know how to avoid the accidental ingestion of food allergens under different situations, such as when selecting, cooking, and eating food. Third, the nutritional status of the patient should be assessed. Patients should also be aware of the nutrients that will tend to be deficient after causative foods have been eliminated from their diet and understand that a balanced diet is important for maintaining good nutrition. There are other points that patients should be aware of depending on their life stage. Patients can reduce their anxiety about their diet and that of their children by receiving related advice during pregnancy and lactation, on the progression of baby food, on correspondence at nursery centers and school lunches, and on precautions to take when eating out and when expanding their diet after oral food challenges. Patients face difficulties and anxiety in various aspects of their diet. It is very important for dietitians to work with doctors to support patients and their families through nutritional guidance so that they can lead a safe and comfortable life.

Keywords: food allergy, dietitian, quality of Life

SY(T4)4-1

Looking back on the progress in nutritional management for liver disease

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The liver is the center of nutrition metabolism, and it is known that various nutritional metabolic disorders occur in liver disease. Here we present an overview of the transition of nutritional interventions for patients with liver cirrhosis and non-alcoholic steatohepatitis. Nutritional therapy for liver disease in Japan consisted of a low-protein and carbohydrate-dominant diet before the 1940's, but since then it has changed to a high-protein high energy diet. However, due to the westernization of the Japanese diet, the number of obese people has gradually increased, and a balanced diet has been the basic dietary therapy since the 1970's. Patients with liver cirrhosis have abnormalities not only of carbohydrate, lipid, protein, and amino acid metabolism, but also vitamin and trace element metabolism, and it has become clear that imbalance of plasma free amino acids is involved in decreased utilization efficiency of early morning fasting carbohydrates and in protein/amino acid metabolism abnormalities, and hypoproteinemia, hyperammonemia, negative nitrogen balance, etc., are also observed. As nutritional intervention methods, eating before bedtime as a measure against abnormal energy metabolism and oral branched-chain amino acid preparations for treatment of abnormal protein and amino acid metabolism have been used. Since fatty liver and NASH are frequently associated with lifestyle-related diseases such as obesity, glucose tolerance abnormality, hyperlipidemia, and high blood pressure, it is basic to carry out a diet therapy consistent with these disease states, and it is recommended that patients receive regular nutrition education and avoid sudden weight loss due to diet. Clinical practice guidelines for liver cirrhosis and fatty liver/NASH were published in the 2000's, and standard evidence-based nutritional interventions have become more common.

Keywords: nutritional disorders, liver cirrhosis, non-alcoholic steatohepatitis (NASH), branched-chain amino acids (BCAA)

SY(T4)4-2

Recent progress of nutritional management for liver cirrhosis

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Evidence-based Clinical Practice Guidelines for Liver Cirrhosis have been updated in 2021 by The Japanese Society of Gastroenterology/Japan Society of Hepatology. In the guidelines, the flowchart for the nutritional therapy was revised based on the accumulated evidence. In this session, I summarize the updated points for nutritional therapy.

The initial step of nutritional therapy is assessment. Nutritional status is evaluated by the following three criteria: 1) serum albumin level < 3.5 g/dL, 2) Child-Pugh class B/C, 3) sarcopenia. Patients who fulfill any of the above three criteria are considered as having malnutrition. In particular, sarcopenia is recently known as an independent prognostic factor and should be paid attention to. For cirrhotic patients with malnutrition, the 1st-line nutritional therapy is divided meal/late evening snacks (LES). LES is originally developed for the improvement of nocturnal starvation. Nocturnal starvation is frequently seen in cirrhotic patients while asleep and is associated with disease progression. One of the pathogenesis for nocturnal starvation is a decrease in hepatic glycogen, which results in an energy shortage while asleep. Whereas, LES acts as an energy source and helps to maintain blood glucose concentration while asleep, leading to the improvement of nocturnal starvation. In addition, LES exerts beneficial effects on hepatic biochemical parameters including albumin, ammonia, and prothrombin time. LES is also reported to suppress the development of ascites and hepatic encephalopathy.

In case of worsening nutritional status after treatment with LES, the 2nd-line nutritional therapy is oral branched-chain amino acids (BCAA) agents. There are two types of oral BCAA agents in Japan such as BCAA granules and BCAA-enriched supplementation. BCAA granules consist of L-isoleucine, L-

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DOI: 10.1159/000530786

leucine, and L-valine, and are approved for hypoalbuminemia in decompensated cirrhotic patients with sufficient energy intake. BCAA-enriched supplementation consists of BCAA, other amino acids, lipids, carbohydrates, minerals, and vitamins. BCAA-enriched supplementation is approved for malnutrition in patients with chronic liver failure accompanying hepatic encephalopathy. Moreover, several clinical studies have demonstrated that BCAA inhibits the development of hepatocellular carcinoma and prolongs the overall survival of cirrhotic patients. Although the precise mechanisms are under investigation, BCAA is not a simple nutrient and is considered a pharmacological nutrient for patients with liver cirrhosis.

Carnitine and zinc are nutrients associated with various metabolisms including ammonia detoxification. In patients with cirrhosis, carnitine and zinc deficiencies are highly prevalent. Therefore, supplementation of these nutrients is recommended for cirrhotic patients with hepatic encephalopathy and deficiency of carnitine and zinc. In addition, supplementation of these nutrients is thought to be beneficial for sarcopenia in cirrhotic patients.

In conclusion, an assessment of not only liver function but also sarcopenia is crucial for the nutritional management of cirrhotic patients. For cirrhotic patients with liver failure/sarcopenia, LES should be considered as a 1st-line nutritional therapy. Then, BCAA agent should be considered as a 2nd-line therapy. In addition, carnitine and zinc deficiencies are highly prevalent in patients with liver cirrhosis. Supplementation of these nutrients contributes to further improvement of the nutritional status of cirrhotic patients.

Keywords: Liver cirrhosis, Sarcopenia, BCAA, Carnitine, Zinc

Conflict of Interest Disclosure: Takumi Kawaguchi received lecture fees from Janssen Pharmaceutical K.K., EA Pharma Co., Ltd., Otsuka Pharmaceutical Co., Ltd., and Taisho Pharmaceutical Co., Ltd.

SY(T4)4-3

Impact of treatment of diabetes in patients with no-alcoholic fatty liver disease

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Aims: Specific treatment for non-alcoholic fatty liver disease (NAFLD) was poorly developed. The patients with diabetes mellitus are frequently complicated with NAFLD. However, the impact of diabetes treatment and genetic background in NAFLD are unclear. In this study, we investigated the clinical course for treatment of an oral hypoglycemic agent (OHA) for one year. Methods: The 544 patients (275 men; 50.6%) enrolled in the study had biopsy-confirmed NAFLD and a median age of 53 (range: 10-84) years. There were 272 patients without diabetes, and 64, 141 and 67 with type 2 diabetes not treated with an OHA, with an OHA and insulin, respectively. 1) Changes in biochemical parameters and body weight over 1 year were determined in patients treated with incretin agents (n = 91), a sodium glucose cotransporter 2 inhibitor (SGLT-2) (n = 19), or both (n = 33). The voltage-gated potassium channel KQT-like subfamily member 1 (KCNQ1) gene was identified as a risk allele for diabetes and assessed the association of the treatment response. 2) The serum level of glucose was measured in 48 cases by continuous glucose monitoring (CGM). Results: 1) Among patients with NAFLD, half had type 2 diabetes and the incidence was high in those with advanced fibrosis. The serum level of transaminase, and hemoglobin^{A1C} was reduced after 1 year of OHA treatment without significant difference regardless of the type of OHA. Platelet counts did not change significantly. The reduction in body weight was higher after SGLT2 treatment ($p = 0.05$) and in the KCNQ1 CC subjects ($p < 0.05$). 2) The serum level of glucose was reduced at night time in patients with mild fibrosis (F0-2, n= 8) in 25 cases and advanced fibrosis (F3-4, n= 4) in 23 cases without significant difference. Conclusions: SGLT2 was effectively treated in NAFLD patients with type 2 diabetes. The patient's genetic background affected the treatment response in patients with NAFLD. The serum level of glucose in night time was reduced even in mild fibrosis cases, we should be aware the hypoglycemia.

Keywords: non-alcoholic fatty liver disease (NAFLD), diabetes mellitus

Conflict of Interest Disclosure: N/A

SY (T4)4-4

Nutritional management for liver cirrhosis in Thailand

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Protein calorie malnutrition (PCM) is a common and important problem in patients with cirrhosis and is associated with functional severity of liver disease. Malnutrition in cirrhosis can be undernutrition or excess in nutrition (patients with NAFLD). The recommended calorie for undernutrition is 35-40 kcal/kg/day and 25 kcal/kg/day for those with nutrition excess. The proportion of nutrient in cirrhosis is 50-55% and 30-35% for carbohydrate and fat, respectively. Protein requirement is 1.2-1.5 g/kg/d and 1.5-2.0 g/kg/d for compensated and decompensated cirrhosis, respectively. Branch Chain Amino Acid (BCAA) is commonly recommended in Thai patients with cirrhosis who could not tolerate recommended amount of protein supplement due to aggravating hepatic encephalopathy. Due to economic-constrain in Thailand, vegetable protein is added as a snack in late morning and afternoon and keep BCAA as a late supper at around 8.00 pm. Nutrition intervention should be divided to 3-4 meals and 5-6 meals for compensated and decompensated cirrhosis, respectively. Fasting over 6 hours should be avoided in cirrhosis, particularly in those with more advanced liver disease. Micronutrient deficiency is also common

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

in patients with cirrhosis, particularly, alcoholic cirrhosis. Micronutrition should be evaluated and supplemented accordingly. Due to insulin resistance, overt hyperglycemia can occure up to 15-37% in patients after nutritional management, FBS and postprandial BS should therefore be assessed and adding insulin in those who develop overt hyperglycemia.

Optimal nutritional management is one of the key factors to not only improve patients' survival but also quality of life.

Keywords: Nutrition, Cirrhosis, PCM

Conflict of Interest Disclosure:

Receipt of grants/research support: Gilead Sciences, Roche Diagnostic, Janssen, Fibrogen, VIR, GSK

Participation in a company-sponsored speakers' bureau: Bristol-Myers Squibb, Gilead Sciences, Bayer, Abbott, Eisai, Roche, Takada, DKSH, Viatris and Sysmex

SY(T4)5-1

Dietary fats and cardiovascular disease – Dispelling the myths

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Cardiovascular diseases (CVD) are the greatest cause of death globally. High intakes of dietary saturated fatty acids (SFA) have been linked to an increased risk of cardiovascular events, primarily through their association with raised serum low density lipoprotein (LDL) cholesterol, and their reduction has formed the backbone of dietary guidelines to prevent CVD for decades. However, there is some confusion over what should replace SFA in our diets. Evidence indicates that replacement of SFA with carbohydrates, particularly refined sources, has minimal benefit to CVD mortality. Whereas replacement with unsaturated fats, particularly cis polyunsaturated fatty acids, has beneficial effects and is a recommendation in current guidelines. However not all SFA are equal and foods rich in SFA have differential associations with CVD risk. The associations of dietary sources of dietary fats, including dairy, meat and plants will be presented. The evidence for the associations of dairy and CVD will be discussed and potential mechanistic links between saturated fats, dairy foods and CVD risk factors will be explored.

Keywords: Dietary fats, Saturated fats, Cardiovascular diseases, Dairy, LDL-cholesterol

Conflict of Interest Disclosure: Deputy Chair of the UK Government's Scientific Advisory Committee for Nutrition (SACN) and a member of the SACN saturated fats and health working group.

Chair of the ILSI committee on Individual saturated fats and cardiovascular risk factors.

SY (T4)5-2

Cardiovascular benefits of whole grain consumption: evidence explained and mechanisms explored

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There is increasing evidence that high consumption of whole-grain food is associated with low risk of chronic disease such as cardiovascular disease and type 2 diabetes. The bulk of the evidence for the benefits of wholegrain comes mainly from observational studies, but evidence of benefit in intervention studies is increasing. Most of the biologically active compounds found in a grain are located in the germ and bran compartments, and include B vitamins and minerals, amino acids, essential fatty acids and vitamin E. The bran also contains a range of insoluble and soluble fibres, and numerous phytochemicals, (phytates, phenolics, phytosterols), some presenting potential anti-inflammatory properties. The composition differs between types of wholegrain, which could determine different physiological responses with regard to markers for cardiovascular risk. Research has particularly focused on b-glucan-rich cereals such as oats and barley for their potential effect on serum cholesterol concentration and postprandial glycaemia. However, other beneficial physiological effects have been suggested such as blood pressure lowering and inflammatory markers' reduction, improvement of vascular function and increasing satiety. The mechanisms involved remain to be fully elucidated but phenolic compounds, predominantly covalently bound to the fibre, can be released and metabolised by the colonic bacteria into bioavailable bioactive compounds which could exert antioxidant and anti-inflammatory activities in the gut and in other tissues. Changes in the gut microbiota composition and functionality, initiated by increased wholegrain consumption could also lead to functional and metabolic changes resulting in favourably modulating some cardiovascular risk markers. The presentation will critically review the evidence to date regarding the cardiovascular benefits of increased wholegrain consumption and provide an overview of the potential mechanisms involved.

Keywords: Human Nutrition, Wholegrain, intervention trials, cardiovascular disease

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T4)5-3

Fibre interventions for colorectal neoplasia prevention: a re-evaluation of design and interpretation considerations.

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Diet advice to cancer survivors, especially in colorectal cancers, is generally to follow guidance aiumied at the primary prevention of the disease (fibres, lower protein, salt, meat). However, the underlying data to support the efficacy of this approach is sparse. To date intervention studies with dietary fibre to prevention cancer recurrence (including both pre-cancerous and cancerous lesions) is sparse. This lecture will review the guidance, assess the assumptions and available trial evidence. It will then review factors affecting cancer recurrence to explore why trials have generally not been effective (at prevention of recurrence).

Keywords: cancer, fibre, neoplasm

Conflict of Interest Disclosure: No conflicts to declare

SY (T4)6-2

Nutritional management in elderly CKD patients in Japan

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The number of chronic kidney disease (CKD) patients is increasing globally because kidney function is affected by aging and lifestyle habits. Malnutrition, muscle weakness, and a decline in activities of daily living (ADL) are often observed in elderly CKD patients and dialysis patients and are related to their CKD prognosis and life prognoses. Chronic inflammation and atherosclerotic disease are associated with malnutrition. Because malnutrition and its related factors affect patients' prognoses, it is necessary to identify and treat patients with malnutrition at an early stage. The state in which the stored protein and energy sources are reduced in CKD is called protein energy wasting (PEW). PEW is diagnosed on the basis of biochemical test findings such as hypoalbuminemia, unhealthy physique, and decreased muscle mass and dietary intake. For evaluating PEW, a complex nutritional index taking into account the pathophysiology specific to CKD patients is useful. Not only nutritional therapy but also exercise therapy is necessary to stop the vicious cycle associated with PEW and the decline in ADL.

Keywords: chronic kidney disease, protein energy wasting, inflammation, dialysis, elderly

Conflict of Interest Disclosure: None.

SY(T4)6-3

Nutrition Management for Patients with Chronic Kidney Disease

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Loss of appetite and anorexia are among the earliest and most common symptoms in patients with chronic kidney disease (CKD). The CKD-related malnutrition prevalence is 28%-48% in CKD stage 1- 4 (glomerular filtration rate (GFR) ≧ 90 - 15mL/minute/1.73m^2), and up to 75% in end-stage kidney disease (ESKD) (GFR < 15mL/minute/1.73m^2) (1). Nutrition management in CKD patients is very delicate and complicated, and must be adapted to every single individual, race, culture, age, palatability, kidney disease (KD) and comorbidities. Sodium, potassium, phosphorus, and calcium should be taken into account in their daily diets. The excessive sodium intake would worsen hypertension, and heart failure, and hence must be ≦ 2000 mg/day. The hyperkalemia (> 5.4 mmol/L) can cause fatal consequences (arrhythmia, ventricular fibrillation, respiratory muscle paralysis…); the Kidney Disease Improving Global Outcomes (K-DIGO) 2020 (2) suggests: in CKD 1-4 adults, the increased fruit and vegetable intake may decrease body weight, blood pressure, and net acid production though they contain a lot of potassium. The phosphorus and calcium intake should be adjusted to maintain their levels in the normal range. If their serum levels elevate, they can deposit in the tissues (like heart, vessels, coronary artery), and cause life-threatening complications. Also, a fluid restriction may be required (especially in ESRD or dialysis) as excessive fluid intake can lead to volume overload, and cause hypertension, congestive heart failure, and even acute respiratory failure (1). Regarding the protein intake for non-diabetic CKD 3 – 5 adults (2), under close clinical supervision, a protein restriction regime would reduce the risk for ESKD or death and improve quality of life: – 0.55 – 0.60 g dietary protein/kg (weight)/day, or – 0.28 – 0.43 g dietary protein/kg (weight)/day with additional keto acid/amino acid analogs to meet protein requirements (0.55 – 0.60 g/kg (weight)/day) – 1.0 –1.2 g protein /kg (weight)/ day to maintain a stable nutritional status for patients on dialysis (maintenance hemodialysis/peritoneal dialysis). For Diabetic and CKD patients not on dialysis, KDIGO 2020 GUIDELINE FOR DIABETES MANAGEMENT IN CKD (3) suggests maintaining a protein intake of 0.8 g protein/kg (weight)/d, and they should consume an individualized diet high in vegetables, fruits, whole grains, fiber, legumes, plant-based proteins, unsaturated fats, and nuts; and lower in processed meats, refined carbohydrates, and sweetened beverages. However, the protein restriction may not be proposed to all patients with CKD, since it is not adapted to patients with high comorbidities, malnutrition (predictor of bad outcomes when patients go on dialysis) or poor life expectancy and since patients may not want to limit their protein intake(4) Additionally, for metabolically stable adults with CKD 1– 5D or post-transplantation, the energy intake of 25 – 35 kcal/kg (weight)/ day based on age, sex, level of physical activity, body composition, weight status goals, CKD stage, and concurrent illness or presence of inflammation would help to maintain

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DOI: 10.1159/000530786

normal nutritional status (2). Lastly, for CKD 3-5D or post-transplantation adults with inadequate dietary intake, it is reasonable to consider multivitamin supplementation including all the water-soluble vitamins, and essential trace elements to prevent or treat micronutrient deficiencies (1).

Keywords: Chronic Kidney Disease, Nutrition, KDIGO
Conflict of Interest Disclosure: There is no conflict of interest
Further Collaborators: no

SY(T4)6-4

Nutritional evaluation in patients undergoing dialysis

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Patients with ESKD, especially those receiving dialysis, often show characteristic loss of muscle and fat mass, termed protein energy wasting (PEW). PEW is associated with poor prognosis. At the same time, life extension has led to unexpected geriatric syndromes such as frailty and sarcopenia. Maintenance of nutritional condition has a key role in defending against PEW, frailty, and sarcopenia in elderly patients undergoing dialysis. To counteract these disorders, appropriate nutritional evaluation is indispensable. Although a composite nutritional assessment including malnutrition inflammation score is preferable, it is not easy to perform the nutritional assessment in clinical settings in Japan. Another problem may be the cut-off value of each component in PEW. For example, direct adaptation of original PEW criteria for Asian patients is difficult, considering the relatively low level of serum albumin (mean level: 3.6 g/dL) in Japanese patients undergoing dialysis. Therefore, nutritional risk index for Japanese hemodialysis patients (NRI-JH) has been proposed according to the concept of PEW. NRI-JH is calculated based on serum albumin, serum total cholesterol, BMI, and serum creatinine, with considerations for age and sex. Patients were divided into low-, medium, and high-risk groups. Inclusion of creatinine in this index may reflect an aspect of sarcopenia as a surrogate marker of muscle mass. A considerable overlap of PEW, sarcopenia, and frailty is expected, though little information is available because of the lack of clear each diagnosis. As compared to a diagnosis of frailty, the criteria for sarcopenia presented by the Asian Working Group on Sarcopenia are clear (AWGS 2019). Recently, it has been reported the direct relationship between nutritional status assessed by NRI-JH and sarcopenia evaluated by the AWGS 2019 criteria in 315 Japanese patients undergoing hemodialysis. The prevalence of sarcopenia was 44.1%. The prevalence of medium-/high-risk patients was 31.1%, of whom 64.3% were diagnosed with sarcopenia, suggesting a profound association of nutritional disorder with sarcopenia. Since NRI-JH has been developed based on one-year mortality, it was not clear whether it can predict long-term mortality. A recent study showed a significant relationship between NRI-JH and long-term all-cause mortality in 3046 Japanese patients undergoing hemodialysis. In addition, NRI-JH predicted CVD mortality and infection-related mortality in that study. A novel NRI-JH is an objective tool based on practical measurements and repeated use of this index may be useful for evaluation of need for nutritional intervention. An appropriate nutritional status can result in maintaining physical activity that can protect PEW, sarcopenia, and frailty in elderly patients undergoing dialysis.

Keywords: dialysis, nutrition, protein energy wasting (PEW), nutritional risk index for Japanese hemodialysis patients (NRI-JH), sarcopenia

SY(T4)7-1

Reciprocal interplay of ZIP4 and ZNT1 in zinc absorption

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Cellular zinc homeostasis is maintained by the cooperative functions of two zinc transporter family proteins, Zrt-/Irt-like protein (ZIP) and Zn transporter (ZNT), as well as by the cytosolic zinc-binding protein metallothionein (MT). The zinc homeostatic proteins ZNT1 and MT function in dampening increases in cytosolic zinc concentrations. Conversely, the expression of ZNT1 and MT is expected to be suppressed during decreases in cytosolic zinc concentrations. Thus, ZNT1/MT homeostatic responses are considered to be essential for maintaining cellular zinc homeostasis because cellular zinc concentrations are readily altered by changes in the expression of several Zrt-/Irt-like proteins (ZIPs) under both physiological and pathological conditions. However, this notion remains to be tested experimentally. Here, we investigated the aforementioned homeostatic process by analyzing ZNT1 and MT protein expression in response to ZIP expression. Overexpression of cell-surface-localized ZIPs, such as ZIP4 and ZIP5, increased the cellular zinc content, which caused an increase in the expression of cell-surface ZNT1 and cytosolic MT in the absence of zinc supplementation in the culture medium. By contrast, elimination of the overexpressed ZIP4 and ZIP5 resulted in decreased expression of ZNT1 but not MT, which suggests that differential regulation of ZNT1 and MT expression at the protein level underlies the homeostatic responses necessary for zinc metabolism under certain conditions. Moreover, increased expression of apically localized ZIP4 facilitated basolateral ZNT1 expression in polarized cells, which indicates that such a coordinated expression mechanism is crucial for vectorial transcellular transport. The ZIP-driven ZNT1 expression mechanism reported here to function in polarized cells is expected to be operative in zinc absorption in enterocytes, with ZIP4 and ZNT1 being involved in the process. Our results provide novel insights into the physiological maintenance of cellular zinc homeostasis in response to alterations in cytosolic zinc concentrations caused by changes in the expression of ZIPs.

Keywords: zinc, transporter, polarized cells, absorption, intestine

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: There are no competing financial and non-financial interests.

SY(T4)7-02

Clinical and societal implication of vitamin insufficiency.

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Non-communicable diseases (NCDs) are serious health problems in developed countries. For their prevention, life-style modification can play important roles, and the significance of vitamins in the health promotion must be considered from such viewpoint.

Vitamin deficiency causes classical deficiency diseases. Examples with the responsible vitamins in the parentheses include beriberi (vitamin B1), pellagra (niacin), scurvy (vitamin C), rickets and osteomalacia (vitamin D), and coagulation abnormality (vitamin K). These severe deficiency diseases are generally considered to be mostly overcome in developed countries, and the significance of vitamins in health promotion is often overlooked. Recently, however, vitamin insufficiency has been receiving increasing concern. Vitamin insufficiency, which is milder than deficiency, does not cause such diseases, but is associated with the increased risk of NCDs. Patients with vitamin deficiency have typical phenotypic changes, and can be individually diagnosed. In contrast, although vitamin insufficiency is related to the increased disease risk, it is not accompanied by the phenotypic abnormalities in each subject. Therefore, it cannot be diagnosed individually, and tends to receive little attention.

Much more amount of vitamin is needed for the prevention of insufficiency than that of deficiency. “How much vitamins do we need for health promotion” is greatly influenced by the indices based on which we define the required vitamin amount; deficiency or insufficiency. Considering the social background that NCDs are the leading cause of morbidity and mortality in developed countries, vitamin requirement must be defined based on the disease risk.

Recently, breakthrough drugs with robust evidence for true endpoint have been developed for various diseases. For example, in the case of osteoporosis, bisphosphonates, which are potent inhibitor of bone resorption, improve the surrogate endpoint such as the bone mineral density, and markedly decrease the incidence of fragility fracture. Nutritional therapy is not so potent as the treatment effects of novel breakthrough drugs, which, however, does not preclude the importance of nutritional therapy.

Intervention by drugs to subjects with high risk for fracture is cost-effective. However, because of the limited number of subjects in the high-risk group, absolute number of fractures prevented is limited. In contrast, those in the low to intermediate risk comprise most of the population, and the absolute number of fractures occurrence are large, despite the lower risk in each subject. Drug intervention for low to intermediate-risk subjects is unsuitable considering the cost and the concern for the adverse events. A previous systematic review has reported that oral nutritional supplements use in the community produce an overall cost advantage or near neutral balance, often in association with clinically relevant outcomes, suggesting cost effectiveness. Then, prevention through lifestyle modification such as nutrition and exercise should be considered. Thus, vitamin insufficiency is a significant risk for various diseases, and its correction can be of great clinical and societal significance.

Keywords: vitamin, deficiency, insufficiency, disease risk

SY(T4)7-3

Inadequate nutrient intakes in Filipino schoolchildren and adolescents are common among those from rural areas and poor families

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Background: Nutrient needs tend to be directly proportional with growth rates, making adequate nutrition an essential component of childhood and adolescence growth and development. This study evaluated usual energy and nutrient intakes of schoolchildren and adolescents in the Philippines.

Methods: Food and beverage intakes were evaluated using 24-h dietary recalls from a nationally representative sample of schoolchildren aged 6–9 and 10–12 years (n = 3,594 and n = 2,971, respectively) and adolescents aged 13–18 years (n = 5,447). The distributions of usual energy, nutrient intakes, and the prevalence of inadequate intakes – which is defined as the percent of children with intakes less than estimated average requirements or acceptable macronutrient distribution ranges – were estimated using the Personal Computer Software for Intake Distribution Estimation (PC-SIDE) program.

Results: The results showed that macro- and micronutrient intake had a high prevalence of inadequacy, wherein the prevalence of inadequacies was as follows: 12-47% for protein, 38-52% for total fat (as percentage of energy), 92-94% for calcium, 75-90% for iron, 68-96% for vitamin C, 61-93% for folate, 58-81% for vitamin A, 58-91% for Riboflavin, 27-75% for Thiamine, and 18-91% for Phosphorus, such inadequacies also results to a mean energy intake of 19-35% lower than the age group's estimated energy requirement.

Conclusions: In general, adolescents and schoolchildren, especially those from poor families and rural areas, have a high prevalence of inadequacy when it comes to key nutrients for growth. This study demonstrated that nutrient intakes of Filipino schoolchildren and adolescents were highly inadequate, more so among the poor and/or those living in rural areas.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Usual nutrient intakes, School-aged Children, Adolescents, The Philippines

Conflict of Interest Disclosure: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Further Collaborators This research was collaborated by the Nestlé Research, Lausanne, Switzerland.

SY (T4)7-4

Dietary management of phosphorus in CKD patients

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Hyperphosphatemia is a common complication in advanced chronic kidney disease (CKD), especially end-stage kidney disease. Since the kidney plays a critical role in the maintenance of phosphorus balance, dietary management of phosphorus is the first-line treatment of hyperphosphatemia. Dietary phosphorus intake shows strongly positive association with dietary protein intake. Thus, low protein diet, which is a common dietary treatment in CKD patients, is useful for treatment of hyperphosphatemia. Phosphorus to protein ratio is also considered in dietary management for CKD patients with hyperphosphatemia. Phosphorus to protein ratio is different in foods. Consumption of foods with high phosphorus to protein ratio is significantly associated with mortality in end-stage CKD patients. Plant foods and animal foods are sometimes attractive issues. In general, animal foods have higher phosphorus availability than plant foods. A crossover intervention study demonstrated that vegetarian diet consumption lowered serum phosphorus levels compared to meat diet in CKD patients. Another important issue is food additives. Phosphorus-containing food additives are widely used in various food processing, thus processed foods have higher bioavailability of phosphorus rather than natural foods. We recently proposed “phosphatemic index” that is a novel index can reflect the phosphorus bioavailability. Phosphatemic index is based on postprandial increase in serum phosphorus level following the ingestion of various foods as similar as glycemic index. Phosphatemic index can evaluate more accurately the effect of phosphorus containing foods on serum phosphorus levels compared with phosphorus to protein ratio, plant/animal food ratio. Dietary phosphorus restriction can also affect metabolism of other nutrients including minerals and vitamins. I will discuss dietary management of phosphorus in CKD patients from metabolic points of view.

Conflict of Interest Disclosure: The authors declare that they have no conflict of interest.

Keywords: chronic kidney disease, hyperphosphatemia, phosphorus restriction, vitamin, mineral

SY(T4)8-1

Novel approaches to oral iron supplementation

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Background and objectives: Oral iron supplementation is the first line of treatment for iron deficiency and iron deficiency anaemia. Treatment schedules usually entail the daily provision of a total of 100-200 mg elemental Fe in single or in divided doses. Our objective was to review recent advances and evidence in the field of oral iron supplementation. Methods: non systematic review. Results: Iron absorption from supplements is generally low, 5-25 percent when administered in fasting state, and 0.5-13 percent when consumed with meals. Recent studies suggest that oral iron doses less or equal to 60 mg elicit an acute iron-induced rise in hepcidin, which reduces iron absorption of a subsequent dose at 24 h, but not at 48 h. Alternate day dosing provides higher fractional iron absorption than daily dosing and may, by providing an overall lower Fe dose, lower gastrointestinal side effects. Dividing high iron doses into multiple lower doses spread over the day does not provide benefits regarding the total amount of iron absorbed and should not be recommended. Recent guidelines suggest that daily morning doses of 50-100 mg iron on alternate days may be a viable treatment option for oral iron supplementation in iron deficient patients with or without mild anaemia. Conclusions: To be widely adopted, these findings need further confirmation in different patient groups, in long-term double blind, randomized controlled trials.

Keywords: chronic kidney disease, hyperphosphatemia, phosphorus restriction, vitamin, mineral

Conflict of Interest Disclosure: None

Further Collaborators: Nicole U. Stoffel, Michael B. Zimmermann

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T4)8-2

The Emerging Role of Vitamin D Deficiency in Anemia

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Background and objectives: Vitamin D deficiency and anemia are common and often coexist in populations suggesting that vitamin D may be involved in the etiology of anemia.

Our objectives were to examine: 1) the mechanistic evidence linking vitamin D to anemia, 2) the human observational evidence linking vitamin D status to anemia, and 3) and the effect of vitamin D supplementation on anemia.

Methods: We conducted a comprehensive review of the current evidence linking vitamin D to anemia.

Result: Vitamin D appears to increase the amount of iron available for red blood cell synthesis by reducing hepatic hepcidin synthesis. This hormone binds to ferroportin and blocks cellular iron export.

An association between serum 25-hydroxyvitamin D (25OHD), a biomarker of vitamin D status, and hemoglobin concentration has been reported in several studies. The association is weak and is modified by sex, ethnicity, and background rates of inflammation and anemia. Moreover, the association between 25OHD and hemoglobin is not continuous with a threshold effect at approximately 50 nmol/L, above which higher 25OHD is no longer associated with hemoglobin.

Randomized control trials do not support vitamin D supplementation to reduce anemia. Still, studies so far have been small and conducted in heterogeneous populations, including participants without anemia or inflammation.

Keywords: Vitamin D, Anemia, Inflammation, Hepcidin, Iron

Conclusion: Larger, high-quality trials are needed, ideally in participants with a high baseline burden of inflammation and anemia and low 25OHD, to determine the role of vitamin D in anemia.

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T4)8-3

Cognitive and behavioural consequences of iron deficiency in children and women of reproductive age

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Background and objectives: Iron deficiency is a biological risk factor for the failure of >250 million children in reaching their full developmental potential as adults, resulting in significant reductions in economic productivity and perpetuating the vicious cycle of poverty and malnutrition. Here, we review evidence from randomized controlled trials (RCT), published in the past decade, examining the cognitive and behavioral consequences of iron deficiency.

Methods: A review of the literature over the past 10 years was conducted to identify RCTs involving iron intervention with cognitive and/or behavioral assessments in children and women of reproductive age (WRA).

Results: Ten studies assessed the effects of iron treatment on cognitive outcomes in children. Three reported no significant differences between the intervention and the control group after treatment, five reported improvements in cognition favorable to the iron treatment group, and two reported worse cognitive outcomes for children who had been treated with higher vs. lower iron formula. Of the studies that reported no significant differences or worse cognitive outcomes for the treated group, all but one provided the supplementation during infancy; while, for those reporting improvements after treatment, the intervention occurred during the preschool or school age years. Additionally, studies not conducted in Western countries but where Western norms were used to calculate the cognitive scores, were less likely to report a significant difference between groups vs studies that used raw scores. Seven recent studies assessed the effects of iron treatment on behavioral outcomes in children and five reported a lower prevalence of behavior problems or more positive affect in children who received iron; one found no difference in behavioral scores after intervention; and one reported higher ADHD symptoms in those who received iron. In WRA, three recent RCTs examined the effects of iron on cognition (memory, attention, perception); one reported no differences at endline while the other two reported greater cognitive improvements in those treated with iron. Interestingly, the iron status of the women in the studies reporting significant improvements after treatment were significantly lower at baseline, when compared to that of women in the study where no group differences were found after treatment. Three RCTs in WRA also examined behavioral outcomes and fatigue. One reported no differences between groups after supplementation while two reported significant improvements (in fatigue or depressive symptoms) after treatment.

Conclusion: An association between iron deficiency (with and without anemia) and cognition/behavior exists for children and WRA with implications for optimal achievement. Outcome tests chosen as well as the manner in which the test scores are computed need to receive more attention. Well-designed RCTs are needed to better understand the effects of timing, duration,

and severity of the deficiency as well as the optimal treatment timing, duration and dose.

Keywords: Anemia, Iron Deficiency, Cognition, Behavior

SY(T4)8-4

Safety of interventions to reduce nutritional anaemia

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Iron deficiency is estimated to cause more ill health and disability worldwide than any other nutrient deficiency. This underpins a public health drive to combat iron deficiency by interventions on multiple fronts. Many interventions such as increasing dietary diversity, introducing biofortified crops, or improving sanitation and hygiene have no safety concerns, but can have limited efficacy. Direct supplementation with iron in the form of tablets, syrups or point-of-use micronutrient powders have greater efficacy but have been associated with a range of adverse outcomes, especially in the settings of poverty and poor hygiene where they are most needed. These adverse outcomes result from a battle for iron between humans and micro-organisms in which iron can enhance the virulence of numerous human pathogens. This chapter provides a high-level review of the existing evidence that iron interventions increase the likelihood of serious infections by bacteria, protozoa, viruses or fungi, and whether they cause adverse perturbations of the gut microflora. We conclude that the evidence for possible harm is real, but that there are ways to ameliorate the risks, and that the benefits of iron interventions will generally outweigh any risks.

Keywords: Iron, Anaemia Prevention, Safety, Malaria, Bacteria Viruses

Conflict of Interest Disclosure: None.

SY(T5)1-1

Epidemiological evidence of Japanese diet

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Japanese diet has been noted as one of the factors contributing to population characteristics that Japan had the longest average life expectancy in the world since the latter half of the 20th century, a lower ischemic heart disease mortality rate and obesity prevalence compared to Western countries. However, as with “westernization of diets”, adherence to Japanese dietary patterns in the Japanese population appears to be declining even after 2000. Since 2000, several epidemiological studies from U.S. and Japan have reported characters of Japanese diet relating to health outcomes such as cardiovascular disease. Based on previous epidemiological findings of Japanese diet, we defined Japanese Diet Index score based on 9 food items; 7 adhering components (“rice”, “miso soup”, “fish and shellfish”, “green and yellow vegetables”, “seaweed”, “pickles”, “green tea”), 2 non-adhering components (“beef and pork”, “coffee”). Observational epidemiological studies revealed that higher score of Japanese Diet Index is associated with better health and nutrition outcomes; higher nutrient density, lower risk of total mortality, lower risk of cardiovascular disease mortality, lower risk of incident functional disability, and lower risk of incident dementia, longer survival, and longer disability-free survival. However, these findings of observational studies do not directly demonstrate the effectiveness of interventions to change the diet to a Japanese diet. Nowadays, several evidence from intervention studies can also be referred. One randomized controlled trial showed the efficacy that the Japanese diet reduced body fat mass, LDL cholesterol level (major risk factors of ischemic heart disease), hemoglobin A1c level (measure of blood glucose), and C-reactive protein level (inflammatory marker) in overweight adults. Another randomized controlled trial also showed the effectiveness that dietary education of the Japanese diet improved LDL cholesterol level in dyslipidemia patients. Taken together, these findings hold promise that Japanese diet eventually contributes to reduce mortality and prolong healthy life expectancy, although this expectation has not been verified by intervention studies.

References:

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Keywords: Japanese diet, Dietary pattern, Epidemiology, Mortality, Healthy ageing

SY(T5)1-2

Interaction of diet and gut microbiome in Asians and its effect on their health

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Forty trillions of bacterial cells consisting of more than a hundred species of microbes inhabit digestive tract of human being. This microbial community called “gut microbiota” utilizes unabsorbed nutrients from consumed diets in the colon and affects host health through fermentative production of a variety of metabolites. Therefore, gut microbiota can be considered hidden organ and attracts much interest in medical and food sciences. Notably, we have attracted interest in gut microbiota of Asian people with plenty of dietary cultures and established international consortium called “Asian Microbiome Project (AMP)” to collect and share the information about the link among diets, gut microbiome, and health in each population. Thus far, we have conducted four phases study. In Phase I, we investigated gut microbiome of school-age children of five countries as a pilot study. In Phase II, we built up basal database of gut microbiota of Asian people covering from newborns to elderlies. In Phase III, we looked into the interaction of foods and gut microbiota in more depth in certain areas, namely Leyte Island in Philippines and Bangkok and Buriram in Thailand. In Phase IV, we focused on the association of gut microbiome with lifestyle diseases, particularly obesity and type 2 diabetes. As a result, we have gained insights in the following six points. (1) There are two types of gut microbiome in Asians. (2) The gut microbiome mirrors dietary habits in each country. (3) Among Asians, Japanese have unique gut microbiome structure such as prominently high abundance of Bifidobacterium. (4) In developing area, structure and function of gut microbiome are being changed under the modernization of diets. Notably, loss of classical type of dietary habit mainly consisting of crops and vegetables decreases fermentative production of short chain fatty acids which have indispensable role to maintain host metabolic and energy homeostasis. (5) In Japanese study, we found that high consumption of fat and alcohol induces dysbiosis. (6) Asian traditional foods contain ingredients having capabilities of conditioning of gut microbiome. Taken together, although Asian microbiome reflects goodness of Asian traditional foods, the fact that the introduction of modern diets have started remodeling Asian gut microbiome warrants retrospective studies to close up benefits of Asian traditional foods.

Keywords: Gut microbiota, Asian Microbiome Project, Tradition diet, Modern diet, Lifestyle disease

SY(T5)1-03

Characterizing the diets consumed by Japanese based on various dietary variables: Are Japanese diets really healthy?

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Japan is not only one of the world's top countries in terms of longevity, but is also considered to have eating habits that differ greatly from those of Western countries. For this reason, there is a great deal of interest from around the world in the food and eating habits of the Japanese people. However, there are surprisingly few studies that have scientifically and quantitatively measured, evaluated, and compared Japanese eating habits with those of Western people, and how healthy their food and eating habits are, without common sense and preconceptions. Here, the author shows several recent studies that examined the characteristics of the Japanese diet. There is a trend analysis in dietary patterns based on the Japanese National Health and Nutrition Survey 2003-2015. Using repeated, independent cross-sectional designs, dietary intake was assessed by using a 1-d weighed dietary record in 88527 Japanese adults. Using principal component analysis based on the daily consumption of 31 food groups, three dietary patterns were identified: “plant food and fish”, “bread and dairy”, and “animal food and oil” patterns. In the whole sample, the “plant food and fish” pattern score decreased while the “bread and dairy” and “animal food and oil” pattern scores increased. These results suggest continuous Westernization of the Japanese diet. In another analysis based on the Japanese National Health and Nutrition Survey dataset and the US National Health and Nutrition Examination Survey dataset, the quality of overall diet was compared between Japanese and Americans. The overall diet quality was assessed by using Healthy Eating Index-2015 (HEI-2015) and Nutrient-Rich Food Index 9.3 (NRF9.3). The mean total scores of HEI-2015 and NRF9.3 were similar between Japanese and American adults, respectively). However, component scores between the two populations were considerably different. For HEI-2015, Japanese had higher scores for whole fruits, total vegetables, green and beans, total protein foods, seafood and plant proteins, fatty acids, added sugars, and saturated fats, but lower scores for total fruits, whole grains, dairy, refined grains, and sodium. For NRF9.3, the intakes of vitamin C, vitamin D, potassium, added sugars, and saturated fats were more favorable in Japanese, while those of dietary fiber, vitamin A, calcium, iron, magnesium, and sodium were less favorable. Taken together, it appears that although it is widely perceived that the diet consumed by the Japanese population is healthy, recent evidence suggests that the overall diet quality in Japanese adults is far from optimal and that there are different nutritional concerns between Japan and Western countries.

Conflict of Interest Disclosure: Dr. Kentaro Murakami is an Assistant Professor in the Department of Social and Preventive Epidemiology, School of Public Health, University of Tokyo. He is a nutritional epidemiologist whose research interests include validation of dietary assessment methods, assessment of dietary patterns, eating behaviors, and dietary quality, and identification of determinants of healthy and unhealthy eating behaviors.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

After graduating from Hokkaido University (Faculty of Education), Dr. Murakami received his M.S. and Ph.D. degrees in Food Science and Nutritional Science from the University of Shizuoka, Japan. After post-doctoral training at the University of Ulster in Northern Ireland, he moved to Tokyo in 2016. He has published over 150 research papers and serves on the editorial board of several scientific journals, including as a Deputy Editor of the British Journal of Nutrition.

Keywords: Japan, Diet quality, Food, Dietary assessment

SY(T5)1-4

Cognitive health benefits by bioactive compounds in traditional Japanese foods

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Some evidence suggests that characteristic Japanese foods and/or a particular Japanese diet can prevent lifestyle-related diseases. A typical Japanese diet consists of rice, which is the staple food, and fish or soybeans, which is the common protein sources. The protein sources from fish and soybeans are generally effective in the prevention of lifestyle-related disease. With the increase in the aging population worldwide, cognitive impairment has emerged as a significant problem affecting elderly people. There has been increasing interest in food-derived bioactive compounds with potential neuroprotective and brain health benefits, including the prevention of cognitive impairment and dementia. Because initial cognition decline is believed to result from dysfunctional synaptic plasticity, the induction of neuroprotective proteins (including neurotrophic factors, protein chaperones, and antioxidant enzymes) by dietary bioactive compounds appear to contribute towards the prevention of age-related cognition decline. Some bioactive food components have been demonstrated to potentially prevent the age-related cognitive decline in different animal models.

Senescence-accelerated mouse (SAM) strains were established as a model of accelerated aging, and SAM prone 8 (SAMP8) spontaneously exhibits age-related behavioral disorders, including shortened life span and cognitive impairment. Our studies using SAMP8 mice have indicated that prolonged intake of a diet supplemented with soybean peptide and soymilk residue (okara) suppressed age-related cognitive decline compared to that in the controls. In both groups, significant upregulation of brain-derived neurotrophic factor (BDNF) expression via activation of CREB transcription was observed in the brain. Similar results were obtained when fermented soybean (natto) was orally administered to SAMP8 mice. Another study examined the effects of rice, wheat, and buckwheat flour intake on cognitive decline in SAMP8 mice. The mice administered with buckwheat flour showed improved cognitive function compared to those administered with rice and wheat flours. Oral administration of laboratory-isolated buckwheat starch also improved cognitive function as well as BDNF upregulation in SAMP8 mice, suggesting the importance of starch in buckwheat. Furthermore, the buckwheat flour resulted in a significant change in the gut microbiota. This presentation will focus on the beneficial brain health effects of these bioactive compounds in the SAMP8 mouse model and their underlying mechanisms.

Keywords: cognitive function, neurotrophic factor, SAMP8, soybean, buckwheat

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SY(T5)2-1

Child poverty, dietary intake and health in Japan

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Even before the COVID-19 epidemic struck Japan in 2020, Japan's child poverty rate was 13.5% using the OECD definition of 50% of median equivalized household income as the poverty threshold. Child poverty is a social issue that plagues Japan just as in other developed countries. However, studies investigating the association between poor nutritious intake and economic poverty using data on Japanese children are fairly new and have just begun to be reported in recent years. The economic strain affects nutrition intake of children in a myriad of pathways including financial constraints in purchasing food, time constraints and physical and psychological well-being of parents, time constraints of children themselves due to part-time jobs and household chores, and lack of information and skill in preparing nutritious meals. Yet, there has not been much studies investigating what are mediating factors which connect the economic strain and children's dietary well-being. In this presentation, an overview of recent studies which have looked into the mediating factors that affect the dietary well-being of children from poor households in Japan. Then based on these new evidences, it will review Japan's policies to combat child poverty and discuss its adequacy. It then explores policy options for improving the dietary well-being of poor children in Japan.

Keywords: Child poverty, Japan

Conflict of Interest Disclosure: There is no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T5)2-2

Triple Burden of Malnutrition among settled populations and Syrian and Palestinian refugees in Jordan

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Background and objectives: Micronutrient deficiencies, stunting, undernutrition and overweight-to-obesity represent public health concerns in Jordan. A "triple burden," characterized by these coexisting aspects of malnutrition, may especially affect health of refugees dealing with economic, civil and food insecurities[1], likely exacerbated by the COVID-19 pandemic. This review landscapes nutritional burdens across the mix of settled (permanent) and refugee populations of Jordan that may help guide national nutrition policies and in other Middle Eastern countries hosting refugee communities.

Methods: We assimilated evidence from a 2019 National Micronutrient Survey[2], a 2021 UN Relief and Works Agency (UNWRA) survey of Palestinian refugee pregnant women[3] and available clinic-based and published reports[4-8] of dietary inadequacy, food insecurity (by Arab Family Food Security Score[9]), serum micronutrient and blood Hb levels below conventional cut-offs, and indicators of overweight (2<BMI-for-age z-score<3 for adolescents, 25≦BMI<30 for adults) and obesity (BMI-for-age z-score>3 for adolescents, BMI≧30 for adults). Nutrition-specific programs and policies addressing these concerns were reviewed.

Results: In 2019, preschool prevalence of iron (ferritin <12μg/L), zinc (<57 μg/dL and 65 μg/dL for morning and afternoon non-fasting) and vitamins A (<0.7 μg mol/L) and D (<12 ng/ml) deficiencies were 26%, 12%, 8% and 28% among settled residents, and 36%, 13%, 9% and 10% among encamped Syrian refugees[2]; school-aged rates of iron, zinc and vitamins A, B^{12} (<150 pmol/L) and D deficiencies were 31%, 4%, 7%, and 44% among settled Jordanians and 35%, 9%, 7%, 2% and 16% among encamped Syrian refugees[2]; and, non-pregnant women rates of iron, vitamins A, B^{12}, and D deficiencies were 66%, 3%, 19% and 64%, and 68, 3%, 12% and 56%, among settled Jordanians and encamped Syrian refugees, respectively[2]. Anemia was higher among school-aged (11%) and non-pregnant women (36%) in encamped Syrian refugees than settled Jordanians (6% and 24%)[2]. Among clinic-attending Palestinian refugees in 2020, anemia affected 40% of infants, and 24% and 44% of pregnant women in the 1st and 2nd-to-3rd trimesters[4]. Among settled Jordanians and Syrian refugees, stunting affected 7% and 14% of preschoolers while overweight-to-obese rates were 12%-to-16% and 16%-to-6% of school-aged children and 29%-to-30% and 29%-to-40% of non-pregnant women, respectively[2]. Among Palestinian refugees, 23%-to-52% of women were overweight-to-obese, while among households of pregnant women, 35% were moderately (score: 3-5) and 20% severely (score: 6-7) food insecure[3]. Antenatal multiple micronutrient supplementation, guided by implementation research, is planned to start in Palestinian camps in 2022-23 and nationally thereafter[5, 6]. Policy initiatives exist to improve dietary quality, encourage physical activity, regulate unhealthy food marketing, and strengthen nutritional labeling[7]. National vitamin A supplementation program is offered to preschoolers[7]. Ongoing wheat flour fortification with iron, folic acid, zinc, vitamins A, D and several B-vitamins is being evaluated for coverage and effectiveness[7, 8].

Conclusions: Triple burden of malnutrition, across Jordanian populations, is being addressed with increased coordination and evaluation.

Keywords: triple burden of malnutrition, micronutrient deficiency, anemia, food insecurity

SY(T5)2-3

Food support and nutrition management programs for reducing health disparity in Korean children

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South Korea is one of the fastest aging and lowest fertility rate societies, which increased the necessity of developing various programs and policies to ensure sustainability of Korean society. The increasing needs include not only the policies to increase fertility rate, but also the programs and policies to improve the nutritional status of Koreans, especially of infants and young children. NutriPlus program was developed by Ministry of Health and welfare and Korea Health Industry Development Institute, benchmarking the WIC program of U.S. NutriPlus program is a nutrition support program for pregnant & breastfeeding women, infants and young children. Since 2001 Korean National Health and Nutrition Examination Survey data showed that young children of low socio-economic class are vulnerable to malnutrition, the eligibility criteria included household income, age, pregnancy/breastfeeding status, and nutrition risk factors such as anemia, stunting, underweight, and inadequate food & nutrient intake. The program was designed to provide nutrition education and food packages to improve health and nutritional status of the participants. The results of 3-year pilot study from 2005 to 2007 and the nationwide program data since 2008 revealed that the program has been effective in reducing nutritional risk factors of the participants. Although NutriPlus program has been implemented successfully to support nutritionally vulnerable individuals and households, there have also been growing demands for policies to ensure a healthy & safe foodservice in child-care facilities. Under the Article 21 of the 'Special Act on the Safety Control of Children's Dietary Life', the Center for Children's Foodservice Management (CCFSM) has been established by the Ministry of Food and Drug Safety to improve the quality of foodservice in child-care facilities. As of July 2022, CCFSM is run in 234 cities and towns, providing service for foodservice hygiene control, nutritious menu & recipes, and nutrition education for children, cooks, directors, teachers, and parents and to build healthy eating

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

habits and systematic foodservice management. NutriPlus program and CCFSM have been evaluated as good policy models for reducing health disparity and improving nutritional status of children. However, since the health risk factors of children are changing, continuous research is needed to improve the programs and policies.

Keywords: NutriPlus, CCFSM, food support, nutrition education, nutrition policy

SY(T5)2-4

Problem nutrients in the diet of under-five children in stunting priority areas in Indonesia with different food security conditions

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Background and objectives: Given the diversity of dietary patterns and district food security in Indonesia, it is important to identify problem nutrients (PNs) and local-specific food-based recommendations (FBRs) to strengthen infant and young child feeding programs for stunting reduction. This study aims to identify PNs in the diet of under-five children in selected 37 stunting priority districts in Indonesia and assess whether the number of PNs was associated with district food security status.

Methods: Linear programming analysis (LP) using Optifood was used to analyze dietary data collected using a single 24-hour dietary recall in the Food Consumption Survey 2016 conducted by the Ministry of Health, Indonesia. PN was defined as a nutrient that did not meet 100% Recommended Nutrient Intake (RNI) based on Indonesian-RNI in the 2-best-diets scenario. PNs were further classified based on %RNI in the best-case scenario as either absolute (<100%RNI) or partial (≧100%RNI). District food security status was classified based on Food Security Vulnerability Atlas (FSVA) 2018 as either food insecure (score 1-3) or food secure (score 4-6). Districts were categorized as having high numbers of PNs if there were a total of six or more PNs in the four age groups.

Results: The top-3 PNs by age group were: iron, folate, vitamin B12 (6-11mo); folate, calcium, zinc (12-23mo); folate, calcium, vitamin C (24-35mo); and calcium, folate, vitamin C (36-59mo). There were no significant differences in the number of PNs based on district food security status. Out of the 37 districts, only six districts (16%) were categorized as food insecure. Based on combined categories, 15 districts (41%) were food secure and had low PNs, 16 (43%) were food secure but had high PNs, 2 (5%) were food insecure with low PNs, and 4 (11%) were food insecure with high PNs. PNs were mostly absolute problem nutrients, suggesting that the food baskets of the children were lacking nutrient-dense foods despite the food availability in the area.

Conclusions: PNs varied by age group but there was no significant association between district food security status and the number of PNs. Our findings suggest the importance of promoting local-specific FBRs compatible with PNs in different age groups and using the FBRs as a reference for local food production of nutrient-dense foods, both in food insecure and food secure areas.

Keywords: food-based recommendations, food security, linear programming, problem nutrients, under-five children

SY(T5)3-1

The International Breakfast Research Initiative: Development of nutrient recommendations for breakfast for Europe and North America

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Background and objectives: Breakfast is regarded as an important meal and one that is subject to nutritional guidelines to assist governmental institutions, such as schools, to set targets to optimise nutrient intakes at breakfast. To date, no systematic global analysis of actual eating habits at breakfast has been completed that would guide policy makers in devising nutritional standards for breakfast. The present project set out to obtain and interpret such data. The project also explored the cultural variation in the meaning of breakfast in different regions of Asia

Methods: To date, 18 countries have participated in the International Breakfast Research Initiative ((IBRI) covering North and South America, Europe, and Asia. Each centre used their national food consumption database to examine nutrient intakes at breakfast among those at the highest tertile of the nutrient rich food index for overall daily nutrient intake. The proposed ideal nutrient standards for breakfast were based on 20% of the Codex Alimentarius reference nutrient intake for nutritional labelling. In the case of total fat, saturated fat, sodium and added sugars, WHO guidelines were used.

Results: In general, breakfast was found to provide around 20% of total daily energy intake but that figure did not apply to micronutrients where breakfast was rich in many B-vitamins but provided less than 20% of the daily intake of several micronutrients and fibre. Where nutrient intakes at breakfast were below the target levels, a series of principle to set new goals was established. Linear programming software was developed to improve food choice for an optimal nutrient intake at breakfast among those with the lowest overall daily nutrient intake.

Conclusions: The IBRI project has identified methods to optimise nutrient intake at breakfast. These can be applied at national level and, in some instances where the cultural norms of breakfast are similar (e.g. USA and Canada), such findings could be applied at the regional level.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Breakfast

Conflict of Interest Disclosure: The International Breakfast Research Initiative is funded by Cereal Partners Worldwide and the agencies funding national nutrition surveys of participating countries

SY(T5)3-2

Proposed nutrient recommendations for breakfast in Latin America

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Introduction: Several studies have reported a wide variation in the contribution of breakfast to nutrients intake and diet quality in various parts of the world, however data on the Latin American composition of breakfast are scarce.

Objectives: To provide updated data on the breakfast nutritional composition and its contribution to daily intakes among the Latin American population. Also to evaluate the nutritional composition of breakfast in the LA population and propose recommendations for a balanced breakfast.

Methods: 8,714 subjects from 15-65 years old were evaluated in the ELANS study, a multicenter cross-sectional survey conducted in eight Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru, and Venezuela). Dietary data were obtained by two 24-hour dietary recalls. The total intakes and proportion of daily energy and nutrients from breakfast were calculated. Comparison of food and nutrient intake of breakfast across NRF9.3 tertiles were analyzed using the Kruskal-Wallis rank sum test.

Results: On average, ELANS sample consumed 444kcal at breakfast, which accounted for 23% of the total daily EI (ranging 16–27%). The contribution of breakfast to mean daily intakes ranged from >30% of total added sugar, riboflavin and calcium; 20-30% of total protein, carbohydrates, fat, saturated fat, fiber, sodium, vitamins A, D, thiamin, niacin, vitamin B12, iron, potassium, magnesium and zinc; and <20% of total vitamins B6 and C. Individuals in the upper NRF9.3 tertile had, at breakfast, higher intake of key micronutrients such as calcium and potassium and higher intakes of energy, protein, carbohydrates, polyunsaturated fatty acids, fiber, vitamins A, C, and from complex B., and lower intake of added sugar and sodium compared with other tertiles.

Conclusions: Breakfast contributed to the daily intake of B vitamins, protein, and carbohydrates but also added sugar and total and saturated fat intakes for all countries. The proposed recommendations support the nutrient density of existing highest-quality breakfast in the LA population while addressing concerns about nutrients to be encouraged or reduced.

Keywords: Breakfast, Nutrient recommendations, Latin America

Conflict of Interest Disclosure The International Breakfast Research Initiative and this workshop were funded by Cereal Partner Worldwide (Latinamerican and European Studies) and General Mills, INC. (Canadian and United States studies). All the authors have no conflicts of interest to declare. None of the entities mentioned had or have any role in the design or preparation of this workshop.

SY(T5)3-3

What will we have for breakfast? Ethno-nutritional perspective of the first meal of the day

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Background and objectives: Breakfast, as the first meal of the day, varies considerably over time and space. Within the same culture, it changes over time, in terms of content, timing, form of socialization. It differs also regarding the position of the eater in the social hierarchy. Between cultures, it varies in the same ways but with even greater amplitudes. The experience of a breakfast buffet in an international hotel offers a concrete vision of this diversity. What differences between the Anglo-Saxon breakfast with eggs, bacon, fried potatoes, toast, tea... and the French breakfast with coffee, bread, butter, jam; between the Indian breakfast with roti chanay, dalls... masala puris, upuma, idlis and dosas... and the Chinese breakfast based on Congee (Steamed stuffed buns), Wontons, Guilin rice noodles…

Methods: The presentation will be based on a review of the food anthropological literature in order to conduct a comparative analyze. The focus will be put on the diversity of food, of patterns of intake and of importance in the food system.

Results: Adopting an anthropological perspective allows us to place breakfasts in the frame of the concrete food cultures of a social group. That means into the social representations of food and into the meal's patterns, including the organization of the food day (how many food intakes a day and what are their relative weights). We will therefore avoid ethnocentrism that for example considers as universal a food day to be composed of breakfast, lunch, dinner. Some social contexts have two meals a day and some other more than three. However, the globalization of the food market and the dissemination of the nutritional knowledge can promote the Anglo-Saxon breakfast.

Conclusion: This ethno-nutritional perspective invites public health actors to be careful with the "clandestine passenger" of their scientific discourse that could be the food cultures of the western countries. Starting the presentation with the word

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

"breakfast", the reading grill will move to idea of first meal of the day.

Keywords: Breakfast, Food pattern, Meal, Anthropology of food

SY(T5)3-4

A study of breakfast patterns in Indonesia, Malaysia and Philippines

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Background and objectives: This research takes place in the frame of the **International Breakfast Research Initiative (IBRI)** which aims to develop breakfast nutrient guidelines to take in account both breakfast and daily nutrient intakes and the association between the two. As the nature of food and the organisation of this meal itself are strongly determined by cultures, nutrient recommendations for breakfast have to be translated into practical advice, whether for individuals or health professionals.

Methods: The project involved harmonised analyses from three national nutrition databases in Indonesia, (Indonesian Food Barometer), in Malaysia (Malaysian Food Barometer) and in the Philippines (National Nutrition Survey). Total daily nutrient intakes were scored using the Nutrient Rich Food Index, adapted to the policy needs of each country. The top tertile of such total daily nutrient intakes were used to examine the contribution of breakfast to nutrient intake.

Results: Nutrient intakes at breakfast in the top NRF tertile were compared to the standard value of 20% of nutrient intakes derived from breakfast. Based on these data, recommendations for the improvement of nutrient intake were developed in each country.

Conclusion: Each of the participating countries can offer more informed advice on breakfast to national policy makers and when considered together, can help elucidate guiding principles on the formulation of advice on optimal nutrient intakes at breakfast.

Keywords: Breakfast, Nutrient intake, Food pattern, Nutritional recommendations, Food cultures

Conflict of Interest Disclosure The secondary analyses was supported by a grant from Cereal Partner Worldwide

SY(T5)3-5

Translating nutrient recommendations for breakfast into practical advice for individuals and health professionals

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Background and objectives: The derivation of breakfast recommendations on nutrient intake and their translation into culturally tailored food-based dietary advice can help dietitians to develop better public health nutrition strategies to optimize food choices at breakfast. The International Breakfast Research Initiative (IBRI) consortium developed evidence-based nutrient recommendations for a balanced breakfast that could be applied by a variety of end users including policymakers, healthcare professionals and consumers. The objective of this project is to develop tools to translate the IBRI nutrient recommendations for breakfast into practical advice for individuals and to support dietitians in patient education.

Methods: Two research groups based in Austria and Spain will conduct the study. As a first step, an algorithm will be developed to condense 20 nutrient targets from the IBRI Europe and North America recommendations to a single continuous score from 1-100 that could easily be incorporated into a digital tool. French food consumption data from INCA 3 survey will be used to validate the score through analyses of correlations between the proposed score and energy content and energy density of breakfast and overall diet quality. Focus groups will be organised with dietitians and people from the community to identify key features and functionalities required for a digital educational tool for breakfast. Local food consumption surveys will be reviewed to identify the most common food groups consumed at breakfast.

Results: A digital toolkit will be developed and tailored to meet the needs of dietitians to educate patients on the importance of breakfast and how to choose a balanced breakfast. A second intuitive digital tool, based on the breakfast score will aim to educate individuals who don't have access to a dietitian. A pilot study will be conducted with dietitians and people in the community to understand the user-friendliness and practicality of the tools.

Conclusion: This study will explore whether IBRI recommendations can be applied as an evidence base for practical educational tools and campaigns to educate individuals and patients on how to choose a balanced breakfast. We also aim to investigate if the toolkit can be readily adapted to different countries by importing national food composition data and applying the IBRI targets to national dietary reference values.

Keywords: Breakfast, Dietitians, Patient Education, Digital Tools, Algorithms

SY(T5)4-1

Creating a Sustainable Food Future

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Global human population is projected to increase to around 10 billion by 2050 —about 3 billion more mouths to feed than there were in 2010. As incomes rise, people will increasingly consume more resource-intensive, animal-based foods. At the same time, we urgently need to cut greenhouse gas (GHG) emissions from agricultural production and stop conversion of remaining forests to agricultural land. To sustainably feed a population of 10 billion, requires closing three gaps:

1. A 56 percent food gap between crop calories produced in 2010 and those needed in 2050 under "business as usual" growth;

2. A 593 million-hectare land gap (an area nearly twice the size of India) between global agricultural land area in 2010 and expected agricultural expansion by 2050; and

3. An 11-gigaton GHG mitigation gap between expected agricultural emissions in 2050 and the target level needed to hold global warming below 2oC (3.6°F), the level necessary for preventing the worst climate impacts., worldwide food availability will need to increase by at least 70 percent (FAO 2009).

The presentation will begin with an overview of the three gaps. It will then outline a five-course menu to address these 3 gaps: (1) reduce growth in demand for food and other agricultural products; (2) increase food production without expanding agricultural land; (3) protect and restore natural ecosystems; (4) increase fish supply; and (5) reduce GHG emissions from agricultural production. The presentation will draw on real-world examples of how World Resources Institute and others are putting into practice the five-course menu.

Keywords: Sustainable, Food, climate, deforestation

Further Collaborators: Richard Waite, Tim Searchinger, Craig Hanson

SY(T5)4-02

Balancing nutritional adequacy and environmental sustainability: what do we learn from modeling studies?

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Food systems are major drivers of greenhouse gas (GHG) emissions, water, land use, eutrophication (N, P), and biodiversity. Some supply chains are short, others are long, reaching across the globe. The EAT-Lancet commission provided a picture of healthy and sustainable diets for large global regions. However, the evidence base is still scarce on what this means on national and local level, as well as how this translates to consumers and their food choices. Thus, food categories need to be evaluated regarding health-environment-culture-cost trade-offs. Animal products such as meat, especially beef, and dairy have a higher environmental burden than most plant products. For estimating the impact, it is important to differentiate in the type of meat (beef, pork, chicken) and dairy (milk, cheese, yogurt). Moreover, dietary change towards more sustainable diets, should fulfil nutritional requirements, be cultural and socially acceptable, and affordable. Key nutrients that require attention in more plant-based diets (flexitarians, pescatarians, vegetarians, and vegans) and affluent western diets are calcium, iodine, vitamin B12, omega-3 fatty acids, zinc, and iron. However, diets in low and middle income countries would benefit from more (micro) nutrient and protein dense foods from animal sources. Therefore, trade-offs for inclusion of foods in healthy and sustainable diets will differ between western and non-western countries. To evaluate to what extent food categories can be part of sustainable diets, observational and scenario-based approaches, and modeling/optimization strategies have been used. Results indicate that dairy has a moderate impact on sustainability: an emerging rank order is beef, other meat (chicken, pork), (hard) cheese, milk, plant products. Daily intake of 1-2 servings of dairy may fit in sustainable and healthy diets. Yogurt and milk are of special interest, because of their nutrient richness and low fat content, but more studies are necessary to quantify their impact. Sustainable diets can be composed in different ways. Ideally, current local dietary habits and eating cultures should be the basis for change. In future analyses, we need to increase the evidence base beyond summaries of national case studies by using optimization approaches with individual data on dietary intake. Most probably, convergence guidelines which recommend a reduction and substitution rather than elimination approach may be more effective in increasing dietary transition rates for planetary health.

Keywords: nutritional, adequacy, environmental, sustainability, health

Conflict of Interest Disclosure: Member YINI Board, Consultancy Danone

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T5)4-3

Family-based interventions to promote sustainable healthy diets

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Objective: Identifying effective strategies to promote environmentally sustainable and healthy diets is a critical component of creating sustainable food systems. The objective of this presentation is to describe the development, implementation and evaluation of family-based interventions designed to promote sustainable healthy diets.

Methods: Formative assessment with both parents and children were conducted to identify feasible and contextually-relevant intervention strategies to increase intake of plant-based proteins and reduce household food waste. These results informed the development and pilot testing of family-based interventions focused on the promotion of sustainable healthy eating.

Results & Discussion: Findings from pilot studies among families with children aged 9-12 years suggest our intervention strategies are well accepted by families and may increase intake of plant-based protein foods and reduce level of household food waste. Key learnings and next steps regarding approaches to promote sustainable healthy diets will be discussed.

Keywords: food waste, plant-based protein, family, intervention

Conflict of Interest Disclosure: This research is funded in part by funding from Danone Institute International.

SY(T5)5-01

Ideal Models for Mutually reinforcing policies to create a Healthier Diets and Reduce Ultra-processed food consumption

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The push to reduce nutrition-related noncommunicable diseases (NCDs) focused on policies to address our diets. The most successful efforts globally have focused on attempt to reduce ultra-processed foods and beverages (UPFs) high in added sugar, added unhealthy saturated fats, added sodium, and usually refined carbohydrates (HFSS foods). Fiscal policies, more specifically taxes, front-of-the-package food labels (FOPLs}, marketing controls, and school feeding have been the common targets.

In the Nutrition Transition's latest phase, we are seeing increasing consumption of UPFs, These are the unhealthiest proportion of our diet and linked with large increased risk of nutrition-related NCDs and mortality. While most high-income countries are already dominated by consumption of these UPFs, increasing consumption is found in low- and middle-income countries.

While many countries have instituted taxation, mainly on sugar-sweetened beverages (SSBs) mainly though several countries have successfully implemented junk food taxes. No one to date has instituted a broader tax on HFSS foods and beverages though we expect to see such taxes within the next few years.

Also, an increasing number of countries have adopted the only front-of-the-package label (FOPL) system shown to impact food purchases in a large way by reducing intake of the unhealthiest UPFs, the warning label.

It is when we see a combination of these policies created around a common nutrient profile model to identify the unhealthiest UPFs that we see the largest effect. Ideally, we would like to see a warning label on these UPFs combined with not only a strong marketing ban and school food ban for these same UPFs but also a tax on them. Then we have the full constellation of mutually reinforcing laws. And, if the tax revenue is used to promote healthier diets or public health, then their impact would be further enhanced.

Chile and Israel are the two countries which have introduced a wide range of policies. Chile's approach is ideal as all the marketing ban, FOPL warning label, and school bans use the same warning label with its strong cutoffs to identify the unhealthiest UPFs. Israel's policies are comparable, but they are not linked in the same way. We focus on Chile's law and early revaluations of impact.

We then speak of an addition regulation Israel has added, a focus on truly healthy foods that are minimally processed. This component needs to be evaluated as results of other positive logo's have not been shown to be impactful; however, this logos comes with the earlier warning label on other foods and they should work together.

We are still at a very early period in understanding which regulations work, how impactful are they, and what impacts do these make on food purchases and ultimately our diets and health. Reducing ultra-processed food consumption promises to have large impacts on NCD's but these and any changes in child obesity will take time to see. Furthermore, we must begin to develop subsidies linked with the taxes so we can reduce the prices of quality foods such as legumes, fruits, and vegetables for lower income households.

Keywords: nutrition transition, ultra-processed food, front-of-the-package warning label, marketing ban, school feeding

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T5)5-2

Identifying policy priorities for equitable and healthy food environments: a people-centred approach

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Successfully intervening to improve diets is not easy. Evidence, including from studies of people's "lived experience" of food, shows diets are shaped by people's daily realities, which in turn are shaped by underlying systems. These realities include financial insecurity resulting from inequitable economic and livelihood systems, unhealthy food environments rooted in commercially-driven food systems, gender norms influenced by social systems, and deeply-embedded "meanings" of food emerging from cultural systems. These realities combine in people's daily lives to drive populations towards foods that do little to support health or sustainability and away from foods that do.

These realities also shape the ability of policies and actions to have impact on improving diets. Yet efforts to address the problem often fail to consider the full picture of people's realities, so undermining their ability to achieve impact. Given the realities of more marginalised groups are far more challenging, this is particularly problematic for tackling inequalities.

In this context, this presentation will present a tool that enables policymakers, practitioners and researchers to consider the full picture of people's realities relevant to identifying, designing and evaluating policies, programmes and interventions to achieve healthy diets for all. It aims to increase the likelihood of equitable impact by facilitating the selection of portfolio of actions designed and tailored to context and population. Clarifying what the realities are also provides an empathetic space for policymakers and practitioners to gain a deeper understanding of the realities of the people they serve. To address these realities, the tool also indicates who is needed to provide what solutions.

Keywords: TBD

SY(T5)5-3

Salt Reduction Strategies in Thailand

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Evidence has shown that salt (sodium) intake in our population is twice as high as the optimal recommended amount. Sodium intake reduction is one of the best-buy policies recommended by WHO for the prevention of non-communicable diseases especially hypertension, cardiovascular disease, cerebrovascular accident (CVA), and *chronic kidney disease*. High sodium content in packaged food and street food is commonly found in Thailand. This project on reducing sodium intake in Thailand was carried out by the Thai low salt network which was supported by the Thai Health Promotion, Faculty of Medicine, Ramathibodi hospital, Mahidol University, Ministry of Public Health, and the Nephrology Society of Thailand with a goal of 30% reduction in sodium intake among the Thai population by 2025. This project has been successful in many aspects. Project achievements include: 1) In 2015, the 8th National Health Assembly adopted a strategic policy for reducing sodium intake. This led to the implementation of a national strategy for salt reduction by many stakeholders including the ministry of public health, the ministry of education, and public relations agencies 2) Development of a simple salt meter for measuring sodium content in a food sample. Its application enabled people to reduce salt intake and thus reduce blood pressure. 3) Creation of a sodium database of common food consumed in the Thai population and conduction of a national sodium intake survey by measuring 24-hour urinary sodium excretion which revealed the average sodium consumption in a Thai of 3,636 mg/day. 4) Food reformulation in popular dishes by nutritionists and celebrity chefs. Regarding packaged food, a voluntary target of salt reduction was set in conjunction with the Thai FDA and food industry 4 years ago. Since then, with monitoring of sodium content in food and snacks, little progress has been made in the reduction of their salt content. As a result, policies of maximum sodium limit, regulation of their advertisement, and tax measures on high sodium products are in development and undergoing discussions with the food industry. Furthermore, environmental reforms in hospitals, schools, workplaces, and communities to favor a healthy diet were carried out in many parts of Thailand. 5) Food labeling project in collaboration with the Institute of Nutrition, Mahidol University, and the food and drug administration (FDA) including monochrome GDA, and a "healthier" logo was implemented. An interpretative labeling system including traffic lights system and warning signs have also been proposed to the FDA. 6. Using mass and social media as a method of raising public awareness was successful in drawing public interest, resulting in much increased demand of low-sodium condiments, food delivery, and packaged food. These projects contribute to the success of the primary prevention of chronic diseases.

Keywords: sodium reduction, strategies, salt-meter, Thailand, taxation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T5)5-04

Creating a healthy food environment by public-private-academia collaboration in Japan

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Nutrition education is important to encourage people to promote healthy diet, however, education alone exerts a limited effect. It is crucial to create a healthy food environment, including food systems that supply diversified, balanced, and healthy food options.

In Japan, creating a healthy food environment has been promoted in the national health action plan named Health Japan 21 initiated in 2000.

Recently, there are movements by academic societies to support private sectors to produce and sell healthy options. The Japanese Society of Hypertension (JSH) has accredited reduced salt products since 2013. Food companies are responding to this accreditation, and approximately 270 reduced salt products with good taste, such as seasonings, numerous processed fish and meat items, pickled vegetables, noodles, and snacks, are being voluntarily developed by food industries. The total sales of these accredited products increase every year, and the market reached 45.5 billion yen in 2021. The amount of salt provided to consumers has reached 7,376 tons since 2013. There are not any mandatory reformulation schemes in Japan, but this strategy by JSH is a good practice of voluntary food reformulation to reduce salt intake.

Another example involves improving the availability of healthy options in the community. A recent certification system for “healthy meals and healthy environment” was initiated in 2018 for food retailers, restaurants, and worksite cafeterias, which continually provide well-balanced meals termed “Smart Meal”. The certification's criteria were based on dietary reference intakes and other scientific evidence. A consortium consisting of thirteen academic bodies related to nutrition and noncommunicable diseases judge and certify the retailers. At present, 547 retailers have been certified all over Japan. Local governments utilize this certification system to help local restaurants and retailers provide healthy diets. We conducted a non-randomized controlled trial to reduce salt intake in a medium sized company in Saitama prefecture using Smart meal lunch box. After 1 year intervention, significant decrease in salt intake was observed (Sakaguchi K et al. J Occup Health 2021.) Public-private-academia collaboration is critical to promote healthy food environment.

These Japanese initiatives for creating a healthy food environment will be useful information for other countries, especially for Asian countries which have similar food culture.

Keywords: food environment, healthy diet, salt reduction, public-private-academia collaboration

SY(T5)6-01

Critical health literacy in nutrition

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Digital technologies have provided unprecedented access to health information, including information on food choices and nutrition. For consumers the volume of information can be overwhelming. Finding accurate, trustworthy and understandable nutrition information can be challenging for many people. This presentation highlights the importance of developing critical health literacy skills that enable consumers to distinguish between different sources of information, and to find information on food and nutrition that is understandable and useful.

Keywords: Health Literacy, Nutrition, Health education

SY(T5)6-02

Workplace Health Promotion and Health Literacy

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Integration of Occupational Health and Safety (OHS) and Workplace Health Promotion (WHP) aiming at employees' health and well-being attracts attention to WHO's "Healthy Workplace Framework" and NIOSH's "Total Worker Health." In Japan, the Ministry of Economy, Trade, and Industry began certifying health and productivity management brands in 2014, causing significant occupational health promotion. One of the certification criteria adopted is "improvement of health literacy,” which is expected to be an effective intervention. WHP is actively conducted in many companies under health and productivity management. However, there are few studies on the effectiveness of WHP in Japan. Therefore, we examined the impact of workplace health promotion on lifestyle and health literacy based on the practical experience of workplace health promotion by several companies and health promotion programs in the Tokyo area. We also examined the importance of dietary behavior interventions in workplace health promotion, such as company cafeterias and healthy lunch boxes. As an example of occupational health promotion, a design consultant company in Tokyo has conducted various health promotions for about 20 years. Through multiple measures such as the establishment of a health policy, field day and summer festivals, radio calisthenics with the president, healthy lunch box project, round refresh project, and health design handbook, the company has been promoting health literacy (CCHL, Ishikawa2008) and diet, exercise, and sleep indicators. The number of employees has been increasing for five consecutive years. An example of an ICT-based health promotion

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

program is the "Eat, Sleep, Walk" health literacy development project using ICT + nudge + incentive. This project was selected and subsidized by the Ministry of Health, Labour and Welfare's FY2018, and a consortium was established by 15 health insurance unions and Value HR Corporation. On the portal site accessible by PCs and smartphones, helpful content that enhanced health literacy was provided, including a daily e-mail magazine with single-frame cartoons; a daily activity record; distribution of videos on health concepts such as diet, exercise, and sleep; an online walking competition among companies; and a health cafeteria. Participant recruitment was completed in October and December 2018, and about 14,000 people participated. Evaluating lifestyle habits using a before-and-after comparison design, improvements were seen in the following areas: eating breakfast, nutritional balance, sleep duration, exercise, and several steps. In health literacy, the subscales of judgment, communication, and self-determination improved by 5–10%. This project will be continued from 2020 as "Eat, Sleep, Walk + Prevent," with the addition of content on infection prevention during the COVID-19 pandemic. Improving the health literacy of individual employees and organizations is a critical factor in workplace health promotion; we will continue to improve the program and conduct more detailed evaluations. In countries with declining birthrates and aging populations, occupational health promotion will continue to become increasingly important to ensure a healthy workforce and maintain productivity. The goal is thought to improve individual and organizational health literacy, and dietary behavior interventions may also play a role.

Keywords: Health Promotion, Health Literacy, Occupational Health, NCD (non-communicable disease), Health and Productivity Management

Conflict of Interest Disclosure: Hiroshi Fukuda received lecture fees from Value HR Co., Ltd.

Research funds under contract from Credit Saison Co., Ltd (Collaborative Research Programs)

SY(T5)6-03

Health Literacy: An asset for effective nutrition education and communication for behavior change

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Background: Inadequate health literacy affects approximately 26% of the world's adult population, with a majority being the elderly, minority populations, and individuals with limited resources and or possessing less than a high school education. Health Literacy is the degree to which an individual has the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions according to the Institute of Medicine. However, studies indicate that health literacy is an independent risk factor for all-causes of mortality after adjusting for age, race, gender, income, education, health status, and other sociodemographic variables. Fortunately, convincing evidence indicate that addressing health literacy is an effective way to manage health disparities and that health literacy interventions are associated with improved clinical outcomes and health care utilization. It is therefore imperative for health care professionals to assess health literacy levels and utilize the information to develop effective interventions for the low literacy population.

The objective of this session is to discuss factors that contribute to the efficacy of health literacy interventions among adults with low literacy levels by answering the following research questions: 1) What tools are effective in assessing different domains of health literacy? 2) How do researchers and health promotion practitioners use health literacy assessment to design messages that are meeting the literacy levels of the participants? 3) What health education strategies and tools are being successful in objectively increasing knowledge, health literacy scores, and modifying behaviors?

Conclusion: Health literacy interventions among adults should utilize comprehensive baseline assessments to tailor messages to health literacy levels of the participants and employ relevant health literacy approaches such as the use of plain language and the teach back method and have a duration of at least 6 months.

Keywords: Health literacy, assessment tools, intervention approaches, intervention duration, Low literacy adults

SY(T5)7-01

The current situation of school meal organization and solutions to improve the quality of school meals at primary schools in Vietnam

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According to the General Education National Curriculum 2018, primary school students in Vietnam will study two sessions per day. As a consequence, the percentage of schools that provide school meals in Vietnam has increased rapidly, but there is still much concern about quality and effectiveness of school meal plan implementation. This presentation will focus on discussing the actual situation of school meals in some Vietnam primary schools. Solutions to improve the quality of school meals in Vietnam will also be discussed. This work is a part of the project carried out by a research team of the Vietnam Institute of Educational Sciences (MOET) and the Institute of Nutrition (MOH), under the support of the Ajinomoto Foundation.

Keywords: nutrition education, school meal plan, primary education, Vietnam

SY(T5)7-02

Implementing Malaysia School Nutrition Promotion Programme (MySNPP) during COVID-19 pandemic

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Findings from nation-wide nutrition surveys of school-age children showed high prevalence of both over- and under-nutrition problems, with the former a much larger problem. In line with the recommendations of the National Plan of Action for Nutrition of Malaysia III (2016-2025), the Malaysia School Nutrition Promotion Programme (MySNPP) has been developed to contribute towards efforts in promoting healthy nutrition among school children. It focuses on providing nutrition knowledge as well as a supportive school canteen environment in order to bring about various beneficial effects. This presentation provides an overview of MySNPP, including its concept, main components and implementation approach. This presentation also shares experiences and learnings from its implementation in three districts in Johore, during the COVID-19 pandemic when schools were closed most of the time.

The MySNPP comprises two main components: (1) delivery of nutrition education to the children by trained teachers using the Good Nutrition Key to Healthy Children (GNKHC) educational package and (2) provision of daily healthy meal to the children by trained canteen operator during school recess. GNKHC was developed by the Southeast Asia Public Health Nutrition (SEA-PHN) Network, with simple nutrition messages adapted from the national dietary guidelines of the five partner nutrition societies in SEA. In the second component, school canteen food handlers were to be trained to prepare nutritious meals using a revised Healthy Catering Modules of the Ministry of Health and monitored by nutritionists.

With the outbreak of the COVID-19 pandemic in March 2020 in Malaysia and the prolonged duration of the disease, the original implementation plan of MySNPP had to shelved. In 2021, recognising the importance to provide nutrition education to the children during the lockdown, the GNKHC was delivered by trained nutritionists during school holiday utilising an online platform. Modifications were made to the interactive activities of the modules to suit the virtual platform. Local nutritionists from three districts in Johore implemented the 4-day online nutrition education holiday camps in seven schools, involving 34 teachers and 369 primary 3 students. Using an online form before and after attending the holiday camp, the children were found to have showed significant improvement in the knowledge, attitude and practice on nutrition ($p< 0.05$). It was also found that majority of the children, parents and teachers gave positive feedback to the programme.

The online nutrition education component of MySNPP was generally successfully implemented, with positive outcome on the children. It was challenging, but the support of school authorities, parents and children played major roles in this success. Various experiences and learning points were gained from this series of camps organised. Our team will continue to engage more schools and implement GNKHC modules during school holidays in 2022. The provision of nutritious school meals, placed on hold these past years, will be resumed once the situation permits the schools to reopen. In view of the long-term benefits of providing nutrition education to school children, along with a daily nutritious meal, we highly recommend the MySNPP to be implemented to all primary schools in the country.

Keywords: school nutrition promotion programme, food-based dietary guidelines, nutrition education, school meal, knowledge, attitude, and practice on nutrition

Conflict of Interest Disclosure: All authors declare no conflict of interest

SY(T5)7-03

Role of Foodservice Programs for Children in Korea

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Two major foodservice programs play a vital role in improving nutritional status and cultivating healthy dietary habits of children in Korea. One is the School Foodservice Program and the other is the Child Care Foodservice Program. School lunch service started in 1953 as the international relief work for children affected by the Korean War and institutionalized to the School Foodservice Program in 1981 by the enactment of the School Meals Act. The program was rapidly expanded in the 1990s and has been implemented in 100% of the elementary, middle, high, and special-education schools in Korea since 2012. Some schools started to serve universal free lunches to their students in 2011 and 100% of the school lunches served in Korea are free as of the school year 2022-2023. Nutrition teachers or dietitians are stationed in most schools and manage school food service. As nutrition teachers started to replace school dietitians in 2007, the educational role of the School Foodservice Program has grown. While schools were closed due to the COVID-19 Pandemic, the School Foodservice Program still played an important role in providing meal solution for children studying online by delivering foods to home or supplying coupons for lunch boxes sold in convenient stores. The quality of the Child Care Foodservice Program has dramatically increased in terms of nutrition and hygiene since 2011 as the Ministry of Food and Drug Safety started to establish Centers for Children's Foodservice Management. As of March 2022, 236 centers are under operation nationwide. Full time dietitians hired by the centers provide management and technical support for foodservice in child care centers by field visit with counseling, education, and information provision including menu and recipes. They also provide young children enrolled in the centers and their parents with food and nutrition education. Child care centers serve not only lunches but also morning and afternoon snacks, and therefore are responsible for significant proportion of nutritional intakes of young children. For the next decade, the roles of foodservice programs for children in Korea are expected

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

to be increasingly important in the food system transformation for sustainable development.

Keywords: foodservice management, school lunch, nutrition education, sustainable development

SY(T5)7-04

The Contribution of School Lunch Program to Nutrition Management for Japanese Children

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The school lunch program in Japan began in 1889 with the aim of helping impoverished children and became a national project in 1932, with government subsidies, to fight poverty. The school lunch service was suspended due to food shortages during World War II, but it resumed after the war, spread nationwide, and was institutionalized in 1952. In 1954, the School Lunch Act was enacted and the framework for the current school lunch program was legally established. It has been 70 years since the school lunch program started nationwide. According to the 2018 survey, approximately 6.42 million elementary school students and 3.25 million junior high school students use the school lunch program.

School meals consist of a staple food, an accompanying dish, and milk in accordance with the School Lunch Nutritional Standards. Based on the Dietary Reference Intakes for Japanese for one-third of the daily intake, the School Lunch Nutritional Standards stipulate that approximately 40%–50% of nutrients likely to be deficient should be provided through school meals. After World War II, school lunch service effecting the improvement of the physique was confirmed. However, currently with sufficient energy intake, clear effects of the school lunch service on children's physique cannot be confirmed making the evaluation of the effects difficult.

Our research team conducted a dietary survey of fifth graders and compared the nutritional intake of children on school days and non-school days. The results demonstrated that the lunch service played an important role in their nutrient intake. Simultaneously, the survey demonstrated that a higher percentage of children are deficient in several nutrients in low-income households compared to high-income households and that protein intake, especially animal protein intake, was significantly low. For children in low-income households, the impact of school lunch service was greater, suggesting that school lunches reduce the disparity in nutrient intake.

Overseas studies show that obesity tends to be prevalent in poor children, but the disparity in physique is not prominent in Japan, which may be one of the effects of the school lunch service. In Japan, food supply is abundant, and the environment is in place where children can enjoy a rich and varied diet, however there are some problems with nutritional management. During their growth process, the range of eating experiences is narrow for Japanese children. However, the number of food and dishes that they eat for the first time in school lunch service is increasing. Increasing food options and eating a variety of dishes during the growing years leads to balanced food selection and intake behavior leading to the lifelong appropriate nutrient intake and wellbeing. School lunch services not only supply nutrients but also contribute to food and nutrition education as lively learning material.

Keywords: School Lunch Program, Nutrition management, Children

SY(T5)7-05

Promoting health equity through the National School Lunch Program in the United States

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Schools are essential to meeting the nutritional needs of children, millions of whom rely on school meals for at least one meal each day. The National School Lunch Program is a federally assisted meal program that provides nutritionally balanced and free or low-cost lunches to children in schools in the United States (U.S.).

During the 2018-2019 school year, about 28.5 million U.S. children received school meals daily, including nearly 20 million who received a free lunch. In March, 2020, the World Health Organization declared COVID-19 a pandemic. Shortly thereafter, schools across the U.S. closed their doors, and face-to-face instruction was suspended. To facilitate continued access to school meals during school closures, new policies and practices at the federal and local levels were put in place. Waivers issued by the federal government provided school districts with flexibility in distributing school meals safely during the pandemic. These flexibilities included: serving multiple days of meals at once, allowing parents to pick up their children's meals, distributing meals in parks or other non-congregate settings, and providing meals to all children at no charge. Meal pattern flexibilities were also provided. Although these waivers — and the tireless efforts of school nutrition professionals — were critical, they did not address all of the challenges related to serving school meals during a pandemic, including staffing shortages, supply chain disruptions, and transportation barriers. As the COVID-19 pandemic retreated and schools shifted to a hybrid model and eventually back to in-person instruction, school nutrition professionals had to repeatedly pivot to comply with the ever-changing guidance about preventing and reducing the spread of COVID-19 in schools.

More than two years into the COVID-19 pandemic, how have these policies and practices affected the National School Lunch Program and the nation's most vulnerable children? This presentation will provide an overview of school meal programs

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

in the U.S. with a focus on policies, practices, innovations, and impacts before and during the COVID-19 pandemic.

Keywords: school lunch, COVID-19 pandemic, health equity

SY(T5)8-01

The concepts of Indigenous, traditional, and territorial diets and what they offer toward obtaining sustainable and healthy diets

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Sustainable and healthy diets promote all aspects of good health and well-being and have low environmental impact now and for future generations. These diets are accessible, affordable, safe, equitable and culturally meaningful. With planning and care, Indigenous diets, traditional diets, and territorial diets can all meet these criteria. Diets of Indigenous Peoples contain foods and traditions specific to their defined culture as well as commercial foods (ie. Hopi diet); traditional diets also relate to culture and include foods, recipes and traditions for use defined by individual, community, or region (ie. vegetarian diet); and territorial diets refer to diets and ways of eating in a country or geographical region (ie. the Japanese diet). This presentation aims to explore how to build strategies for diets to be sustainable and healthy within these dietary patterns. Importantly, consideration is given to cultural values, history, economy, food qualities and dietary practices, and ecological settings.

Indigenous Peoples, as defined by the United Nations Permanent Forum on Indigenous Issues (UNPFII), are recognized as having experienced sustainable and healthy diets by virtue of their continuous existence over millennia in a defined biocultural location. The collective knowledge of the more than 470 million Indigenous Peoples globally encompasses respect for the interconnection of people with nature and its resources, for the vast diversity of plants and animals as dietary resources, and for the keepers of traditional knowledge that create physical, mental, emotional, and spiritual health. Extensive and continuing research is needed to understand and document these knowledges.

Change for Indigenous diets, traditional diets and territorial diets is constant because of lifestyle change, climate change, changing access to traditional lands and resources, encroachment of others on resources, demographic changes bringing newcomers to a traditional area, and relocation to urban areas and employment. Personal change to dietary patterns results from changing taste appreciations, knowledge and availability of new foods, constraints in local harvests, and intercultural education.

The United Nations Food Systems Summit (UNFSS) of 2021 stimulated reflection on strategies for ensuring safe and nutritious access to food, creating sustainable diets and food systems, boosting nature positive solutions for healthy food for all, advancing equitable livelihoods, and building resilience to food system shocks and stresses. Led by thinking within the Food and Agriculture Organization Global-Hub on Indigenous Peoples' Food Systems (FAO Global-Hub) Indigenous, traditional, and territorial dietary practitioners can offer perspectives on how to meet the UNFSS goals. Suggestions toward creating sustainable and healthy diets include: consider and include diverse cultures and worldviews; ensure free, prior, and informed consent for land/water management to enhance biodiversity-rich practices, include women's empowerment, restore cultural languages and knowledges within intercultural diet and food system education, and provide for self-governance and inclusive contributions to policies.

Keywords: sustainable and healthy diets, Indigenous diets, traditional diets, territorial diets

Further Collaborators: FAO Global-Hub on Indigenous Peoples' food systems

SY(T5)8-02

Incorporating traditional and indigenous foods into food-based dietary guidelines in Africa: opportunities and challenges

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Background and objectives: Globally, Food Based Dietary Guidelines (FBDGs) are an important tool for promoting healthy food consumption habits. In addition, diverse food systems actors can use FBDGs to inform actions supportive to attaining healthy diets from sustainable food systems. However, in Africa, only 9 of the 55 countries currently have FBDGs, the latest being Ethiopia and Zambia that launched their guidelines in 2021 and 2022 respectively. Both Ethiopian and Zambian FBDGs aspire to promote the use of traditional and indigenous foods (TIFs) to improve not just nutrient intake but also resilience in an ever-complex climate change context. Furthermore, the Africa Common Position on the United Nations Food System Summit (UNFSS) identified TIFs as an area requiring much investment for TIFs to play their potential role in improving food consumption habits, nutrient intake, and resilience of African food systems for better food security, as the climate changes. Nevertheless, incorporation of TIFs into FBDGs presents a number of significant challenges. **The objective** was to identify the opportunities and challenges that must be addressed, so that as more African countries embark on developing FBDGs, the incorporation of TIFs can be facilitated so that the potential of TIFs in African food systems and diets can be realized.

Method: The paper uses evidence from a scoping review of literature and the existing FBDGs on the African continent, and outcomes of three independent dialogues of the UNFSS process

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

to identify and describe the opportunities and challenges that limit the incorporation of TIFs in FBDGs towards making recommendations on what needs to be done by different food systems actors.

Results: The challenges identified include limited data on food composition, loss of knowledge on TIFs among the younger components of the population and in urban settings, poor market development, a dietary transition that is leading to the undervaluing of TIFs, and lack of attention and investment from the food and agriculture sector on promoting production as part of agricultural production diversification and value chain development. There are clear opportunities for TIFs to have a positive impact on both nutrient intakes and resilience of African food systems in the changing climate.

Conclusions: There is a deficiency regarding efforts to position TIFs for use in context relevant FBDGs in Africa. For FBDGs to support and promote a shift towards healthier consumption habits and food security resilience, TIF's must be leveraged in efforts of all food systems actors. This would contribute to promoting positive transition to healthier more sustainable diets. In so doing, this would support efforts of the UNFSS 2021 that many African countries are still actively engaged in to promote positive food systems transformation that can deliver better diets and better nutrition and health outcomes.

Keywords: Food based dietary guidelines, Diet transition, Africa, Nutrition, Resilience

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SY(T5)8-03

Engaging Indigenous Peoples in Food Based Dietary Guidelines in Canada: Opportunities and challenges

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Background: This presentation discusses the engagement of Indigenous Peoples in the development of food based dietary guidelines (FBDG) in Canada. Dietary guidelines form the basis of policies and programs to promote healthy eating across the country, and hold particular relevance for Indigenous populations. In Canada, Indigenous populations shoulder nutrition and health inequities resulting from colonial policies that have, and continue, to shape the distinct social determinants of their health status. Policies and programs developed to improve Indigenous Peoples' nutrition will be most impactful when they respect their realities.

Case examples: The last two revisions of Canada's dietary guidelines attended to Indigenous Peoples' expressed needs, each time using a different approach. The 2007 revision process included a needs assessment, stakeholder consultation, and end-user focus groups. An advisory group was created to guide the tailoring of the visual communication tool called 'Canada's Food Guide' which translates dietary guidelines into practical food choice advice for consumers. This process reflected an important policy response in considering the food choices, values and traditions of First Nations, Inuit and Métis, the three constitutionally recognised Indigenous groups. The 2019 revision did not produce a tailored version of the signature communication for First Nations, Inuit and Métis. Those leading the revision noted the absence stating the 2007 tailored version still provided valid guidance. Significant in 2019 were the revised dietary guidelines developed specifically for policy makers and health professionals who implement them. The revision was informed by a consultation process with consumers, and invited Indigenous organisations, and experts to comment on drafts of the document. In the spirit of Canada's reconciliation process with Indigenous Peoples, issues included: a) recognising that health inequities vary among Indigenous groups ; b) citing evidence for the significant nutritional contributions of Indigenous diets; c) identifying challenges in accessing land and water to access traditional food systems; d) describing high rates of food insecurity and lack of access to safe drinking water and; e) considering the social, cultural, and historical context of food skills and food literacy. The recognised role colonial polices play in creating many of these issues is absent, but their recognition will be significant for future policy making to be truly transformative.

Discussion: In a global context, Canada's efforts to address Indigenous Peoples' needs for dietary guidelines stands out. However, Indigenous Peoples' meaningful engagement in these policy processes that impact their food and nutrition has been limited. Without their collaboration on dietary guidelines policy, healthy eating narratives in Canada will undervalue Indigenous knowledges, diversity of food systems and economies, and their contribution to sustainable diets for health. Canada recognises the need for distinctions-based dietary guidelines for Indigenous Peoples. Indigenous communities are generating and translating their own creative dietary guidelines resources and recommendations placing value on Indigenous knowledge and cultural responsibilities that ensure the continuity of sacred and sustainable food systems. This presentation will share some of these examples and outline opportunities for policy development to engage meaningfully with Indigenous peoples.

Keywords: Indigenous Peoples, nutrition, dietary guidelines, policy, decolonisation

Further Collaborators: Sandra Juutilainen, Elisa Levi

SY(T5)8-04

An investigation of the sustainability of National FBDGs and challenges of incorporating traditional foods into FBDGs in Iran

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Background and Objectives: In order to move food consumption toward sustainability, inclusion of elements of sustainability into national food based dietary guidelines (FBDGs) is a priority. We assessed the sustainability dimensions of two modeled diets based on the official national FBDGs introduced in 2006 and 2015 and compared it with the Iranians' usual diet. In addition, we evaluated sustainability of some of the Iranin traditional foods to promote their incorporation into the national FBDGs to emphasize the local food resources and culinary habits.

Methods: Usual dietary intakes of Iranians were estimated using national household Income and Expenditure Survey data. Diet sustainability dimensions, including environmental footprints (water, carbon and land footprints), cost and nutrient rich food (NRF) index were calculated for the usual diet and compared with those of the old and new Iranian FBDGs, the Mediterranean diet pyramid and different vegetarian diet pyramids. Using linear and goal programming, optimal food models were calculated with the aim of minimizing environmental footprints, and cost and maximizing NRF, simultaneously, for each FBDG, while maintaining restrictions recommended by the FBDG, energy preferences, energy intake, macronutrient composition and micronutrient content. Percent change of substituting the usual consumption with dietary models were then compared.

Results: Replacing the usual dietary intake of Iranians with the optimal diet based on the 2016 Iranian FBDG can be associated with 20.9% reductions for water footprint, 22.48% for carbon footprint, 20.39% for land footprint, 31.83% for cost, as well as 7.64% increase in NRF index. The optimal model based on the new FBDGs was 10% more sustainable compared with the previous version. Changing the usual consumption of Iranians to the optimal model based on the Mediterranean Pyramid result in the highest NRF index, while water, carbon, and land footprints and cost were lower compared to other models.

Conclusion: Next generation of food-based dietary guidelines is expected to be more in line with a sustainable diet. Considering the dimensions of a sustainable diet is recommended in designing the next national FBDG. In addition, since traditional Iranian dietary pattern is basically a semi-vegetarian and plant-based diet, translating the guidelines to possible traditional Iranian foods can help through the process.

Keywords: Indigenous Peoples, nutrition, dietary guidelines, policy, decolonisation

Further Collaborators: This abstract is presented for the Symposium: The advantages and challenges of incorporating traditional foods in food-based dietary guidelines (FBDG) for more sustainable and inclusive population guidance

SY(T5)9-01

Connecting the dots: Sport nutrition knowledge, education and eating behaviors in youth athletes.

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Adolescent athletes begin their sport at a young age, yet their knowledge of food and food choices that enhance growth, health and sport performance is limited. As they age, their independence to make food choices increases, yet few receive evidence-based sport nutrition guidance. The diet and physical activity (PA) behaviors learned in these early years can continue into adulthood, thus, impacting long-term health, weight and sport performance. Not all youth athletes will transition into higher level sports, thus, without positive reinforcement to make good food choices and maintain PA, the risk of chronic disease and overweight/obesity increases as adolescents' transition out of their sport and into adulthood. Capturing adolescents while they are still active and engaged in youth sports may be a 'window of opportunity' to cultivate skills that support life-long health and obesity prevention. These skills will also serve them if they transition into collegiate or elite sports. This session will review the results, challenges and lessons learned from a 2-y sport nutrition/PA intervention in ethnically diverse youth athletes (14-18y; ~55% female; ~41% Latino; ~41% low-income), participating in high school soccer. The changes in nutrition knowledge, diet and PA behaviors, food preferences, and supplement use over this intervention will be presented. The state of youth sport research will be reviewed and challenging issues discussed. How can you translate the interest youth have in sport into better eating behaviors for health, growth, and sport performance? How can we help youth adopt healthy diet and PA behaviors they can use for a lifetime? How can we prevent unhealthy dieting, body image, and weight tissues from occurring in young athletes? We will also share our publicly available youth sport nutrition curriculum. If we want youth athletes to make good diet and PA decisions, we must teach them about sport nutrition, and encourage healthy eating behaviors and life-long PA skills.

Keywords: adolescent athletes, ethnic diversity, physical activity, soccer, sport nutrition

SY(T5)9-02

Malaysian perspective: Sports supplement and doping awareness

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Sports supplement is a common sports nutrition strategy that used by athletes for varies reasons. It could be used as intervention for nutrient deficiency / insufficiency, convenient alternative to complement dietary intake according nutrient requirement for sports and ergogenic aid to enhance sports performance. However, the usage of sports supplement could potentially carry risk of anti-doping rules violation (ADRV) among athletes according to World Anti-Doping Code published by World Anti-Doping Agency (WADA). Undeclared banned substance in ingredient list and contamination of banned substance in supplement products are among the cause of unintentional doping among athletes. Questionnaire survey in the area of knowledge, attitude, practice and relation to risk of doping were conducted among Malaysian athletes, both at elite national athletes and young state athletes. Both studies indicated education on appropriate use of sports supplement is important among athletes and it should be provided by qualified nutritionist and dietitian. In order to improve the education level on sports supplement and doping awareness among athletes in Malaysia, plans were initiated and implemented through different strategies. Sports Nutrition Centre under National Sports Institute of Malaysia (ISN) is the main reference point for the national athletes. However, the reach out to state and grassroot level required the empowerment of coaches, through the national coaching course curriculum that include sports nutrition and anti-doping topics. Even nutritionist and dietitian under public health setting should equip with knowledge in this area, going in line with the increasing market of sports supplement products. Sports supplement guideline development project is already underway, which will serve as main reference document in sports nutrition. In summary, the usage of sports supplement can be beneficial to athletes for health and/or sports performance, however appropriateness in usage and doping safety concern are areas that need further improvement among the athletes in Malaysia through strategies at different levels and approaches.

Keywords: Athletes, Nutrition, Knowledge, Banned substance, Doping Safety

Conflict of Interest Disclosure: The presenter declares that there is no conflict of interest

SY(T5)9-03

Prevention and early detection of energy deficiency in free-living athletes

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Athletes have high energy expenditure from daily training. Thus, adequate energy intake equal to the expended energy is essential for optimal health and athletic performance. In athletes, chronic energy deficiency contributes to numerous health issues, including metabolic, reproductive, endocrine, hematological, bone, and gastrointestinal problems. Energy availability (EA) is used as an indicator of energy deficiency. EA is defined as the amount of dietary energy remaining for other body functions after the energy consumed by training is covered. Low EA is the key etiological factor that triggers the unfavorable health and performance consequences in both female and male athletes. EA is calculated as dietary energy intake (EI) minus exercise energy expenditure (EEE), normalized to fat-free mass (FFM). However, there are no clear guidelines for field calculations of EA; accurate assessment of each component of EA (EI, EEE, and FFM) is challenging in the sports field. Since EI is often underestimated, and access to precision measuring equipment of EEE and FFM is difficult, further research is needed to apply EA to free-living athletes. In our latest study of EA, we used a doubly labeled water (DLW) method surrogate for EI and dual-energy x-ray absorptiometry (DXA) for body composition assessment. The results showed that measured resting energy expenditure (REE), REE ratio (measured REE to predicted REE ratio), and triiodothyronine levels could enable early detection of energy deficit. This data will be presented at this symposium. It is crucial to accumulate evidence for the physiological effects of low EA by facilitating studies using accurate quantitative methods; however, DLW and DXA are not field methods. Therefore, other more convenient markers need to be found for nutritional support of athletes in the sports fields. Monitoring REE is one of the simple ways. If REE measurement is not possible, applying estimated energy requirement (EER) using REE prediction equations based on FFM is recommended. Overall, the assessment of EA is not a helpful field tool to detect energy deficiency in free-living athletes. Instead, keeping the energy intake close to the EER goal and bringing the energy balance closer to zero will help to prevent energy deficiency in athletes.

Keywords: energy deficiency, athletes, energy availability, resting energy expenditure

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T5)9-04

Food provision and dietary support at major competition events: The connection between research and practice

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High performance athletes regularly travel and compete at major competition events. Many of these events involve residing in an athletes' village where meals are provided. However, evidence shows that athletes do not always eat suitable food while competing at these events due to inadequate knowledge on the best menu choices or not prioritising performance when choosing what to eat. There may also be environmental barriers to providing suitable food options due to budgets, location or limited experience of caterers. COVID-19 has created additional new challenges for those working in this environment. This symposium will demonstrate how research can be integrated with sports nutrition practice in this unique setting to provide evidence for future change.

Historically, sports dietitians have not consistently been included in the organisation and delivery of food provision and nutrition support at major competition events. Yet, research conducted by those that have attended provides the evidence that teams from different countries have varied degrees of performance nutrition understanding due to limited access to experts with appropriate skills and training in their home environment and therefore rely on suitable food and services provided on site. Those that seek advice from dietitians working at major events have been shown to have dietary intakes that are less than adequate for their general health and sports performance.

Research over the past 20 years demonstrates the positive impact that sports nutrition expertise can have on the food environment at major events through a variety of means including education sessions held with coaches and teams, advice on making weight or recovery, dietary plans for training and competition, and physique assessment. Another identified challenge is the increased demand in therapeutic dietary needs, particularly food allergies or intolerances. Data collected at these events shows around 13% of athletes report following a dietary regimen related to a specific food allergy or intolerance. There is also a wide range of clinical conditions where diet is central to management (e.g. diabetes, coeliac or cardiovascular disease, inflammatory or irritable bowel syndrome) and there is increased demand for personal food preferences such as vegan or vegetarian diets, and natural/organic food. Sports dietitians can play an integral role in planning for food allergy management. Further impact on the food environment can be provided through input into nutrition labelling, staff training, quality assurance checks of menu items and advice on sustainable practices.

Recently, we examined stakeholders' perspectives of integration of nutrition in catering to better understand the barriers and enablers to improving the food provision at major events. The evidence suggests that the integration of sports nutrition expertise into the planning and operational stage of these events has better outcomes in terms of appropriate food for athletes' needs. The food environment at major events has the potential to influence food intake and educate on the importance of nutrition for both health and performance.

Keywords: Nutrition, Athlete, Competition, Sports dietitian, Food provision

SY(T5)10-01

Pathways for Including Social Inquiry Into Nutrition Research: The CeSSIAM Guatemala Experience

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1. The Center for Studies of Sensory Impairment, Aging and Metabolism (Guatemala)

Anthropologists working in Guatemala have long documented violence and human rights violations in the country, shedding light on social inequities among local populations that give rise to health disparities and undernutrition. As a response, important research centers such as INCAP, social science Institutes, and universities led applied anthropology studies to help health and nutrition interventions to work better.

In that context the Center of Studies for Sensory Impairment, Aging and Metabolism (CeSSIAM) was founded with the aim to create new biomedical knowledge and to train young scientists. CeSSIAM biomedical research agenda attracted international doctoral and masters' students who conducted anthropological research. Their studies brought a renewed awareness and led to a more comprehensive social science inquiry pathway.

As a result, the Center has included social research in several mixed-methods biomedical studies. CeSSIAM researchers and exchange students have used ethnographic approached to study, e.g.: health and nutrition worldviews during critical life cycle periods such as pregnancy, lactation, and infancy; food environments; and nutritional transitions. Findings have shed light on different worldviews of nutrition, shaping nutrition and health interventions for the local context, and helping to inform the implementation of Guatemala health and nutrition policy locally. For example, in a zinc-treatment program [in highland Guatemala], local perspectives of illness informed intervention design and evaluation. Adaptations in treatment delivery formats and the use of local concepts of diarrhea by MOH personnel increased treatment adherence.

The interdisciplinary of CeSSIAM's science has not, however, occurred without challenges. Mixed methods studies, in their focus on specific ideas-practices, may not be designed to address social complexities and heterogeneities of context. Capacity building in ethnographic methods takes a significant amount of time, especially for students from biomedical traditions. Additionally, audiences with quantitative backgrounds may not completely understand qualitative findings.

This talk reflects upon the benefits and challenges of integrating social inquiry into nutrition science research. It also shows how designing research to be flexible and to embrace tensions between different disciplinary paradigms can enrich both nutrition-health and anthropology studies.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Nutrition Research, Qualitative Methods, Guatemala

SY(T5)10-02

Translating research on breastfeeding between anthropology and nutrition

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Research on breastfeeding suggests that social and cultural factors affect milk volume, milk composition, and maternal reproductive status (Hausman, 2003), but little is known about how, exactly, culture shapes what and how breastfeeding women eat. This talk describes a study that examined how cultural aspects influence the breastfeeding behaviors of lactating women in the Eastern town of Livingston, Guatemala, a multi-ethnic community where three major cultural groups converge (Garífuna, Maya Q'eqchí, and Ladino). A group of adult women from the three major cultural groups with breastfeeding experience were interviewed to collect information on their dietary intake patterns. Questions focused on: 1) Who guided their breastfeeding practice? (eg.: midwives, family members, or other health professionals). 2) Personal beliefs and perspectives on breastfeeding. 3) Economic deliberations related to dietary intake, including the availability and affordability of foods. We found that lactating behavior of breastfeeding women were mostly influenced by grandmothers, midwives, and health professionals. Recommended lactating practices vary between ethnic groups, based on generations of accumulated knowledge and life experiences. However there is one common denominator: all women use breastfeeding to prevent diseases and infections, for themselves and their children. Working with midwives, who acted as cultural translators, our research team found that all ethnic groups avoided seafood, highly spiced foods, and dairy, believing them to be unhealthy. In contrast, they all ranked simply cooked vegetables as the most consumed food during pregnancy and lactation. Combining nutrition and anthropology to analyze and interpret information ensures a comprehensive study. This comparison among three ethnic groups of lactating women in Livingston, Guatemala, is the first study of its kind. It not only provides valuable confirmation about the importance of cultural beliefs in dictating feeding practices. It also highlights the need for anthropologists and nutrition scientists to work with local communities when carrying out research on food and eating habits.

Keywords: Breastfeeding, lactating woman, Guatemala, anthropology, nutrition

SY(T5)10-03

Maya and Scientific Cultures of Nutrition in Guatemala

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How people classify and describe food affects what and how they eat. This study uses anthropological methods to examine how K'iche' Maya food concepts influence how K'iche' people interact with Guatemala's nutritional food guidelines. In Guatemala, K'iche' Mayan is the largest Indigenous group with about a million speakers. I collected data by employing ethnographic and pragmatic linguistic research methods including dietary records, in-depth interviews, and participatory observation as they prepared food and ate during meal times to contrast with Guatemalan nutrition guidelines. In Guatemala, health policy institutions design and disseminate national food guidelines in Indigenous communities. My research shows how these food guidelines, which are shaped by biomedical cultures, overlooked the religious, cultural, and social values that K'iche' Maya people attributed to food and eating. Using textual analysis and participant observation with K'iche' families as they prepared and ate food, I contrast Maya food classifications with biomedical food classifications. I draw attention to embedded, but often unrecognized, cultural values of standardization and individual responsibility in Guatemala's food guidelines. K'iche' concepts of food have different food domains with regards to the Guatemalan nutrition Guidelines. In multilinguistic and multiethnic contexts, nutrition policy would be improved by attending to the cultural values within nutrition science. Additionally, to strengthen food and nutrition policy, Indigenous knowledge of food must be respected and integrated into biomedical food guidelines.

Keywords: K'iche', Maya, Guatemala, Women, Anthropology of Food and Nutrition

SY(T5)10-04

Anthropology and Nutritional Trial Design in the 21st Century

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1. Albion College (USA), 2. Wuqu' Kawoq (Guatemala)

Guatemala has one of the highest stunting rates in the world. Despite diverse nutritional landscapes, nationally, the under five stunting rate is 49.8 percent. This rate is as high as 75 percent in the rural Maya population. Guatemala's Indigenous Maya communities simultaneously represent the country's cultural richness and ongoing racism and inequality in almost all aspects related to socio-economic well being. These characteristics have

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

made Guatemala a key site for investigations by both (medical) anthropologists and nutritionists. It has also made Guatemala home to numerous non-governmental organizations (NGOs), many of which provide nutritional programming. Too often such programming uses either anthropological or nutritional insights, reifying the arbitrary divide between the “hard” and "soft" sciences. Using examples from their work with the medical NGO Wuqu' Kawoq|Maya Health Alliance, the authors explore the iterative process of nutritional trial design that is both scientifically rigorous and culturally responsible. Examples discussed include multicomponent interventions and community engagement in two specific projects: household gardens and a protein supplementation. Authors will also examine the ethical responsibilities of conducting nutritional trials among marginalized populations.

Keywords: Guatemala, Anthropology, Clinical Trails, Chronic Malnutrition

SY(T5)11-01

The important role of umami taste in oral and overall health

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1. Tohoku University (Japan)

Enjoying tastes should be a life pleasure. However, aging is sometimes associated with reduced taste sensitivity (hypogeusia). Our previous study showed that 37% of test subjects over 65 years of age exhibited lower gustatory function, which is generally assessed with the filter paper disk test in Japan. This test uses a filter paper soaked with a taste-inducing chemical solution that is placed on specific areas of the tongue and soft palate. However, because this test only evaluates four of the five basic tastes: sweet, salty, sour, and bitter, we recently developed the umami taste sensitivity test to be able to evaluate umami taste disorders clinically. Umami taste, the fifth taste category, that is a key flavor in the Japanese traditional diet (*washoku*) rich in umami, is also important for the health of older adults. We have reported the specific loss of umami taste sensation in some elderly patients, while the other four taste sensations were normal. These studies further demonstrated that patients who loss the umami taste sensation had less appetite and lost weight, resulting in a poor overall health. Taste disorders are strongly related to reduced salivary flow. Saliva facilitates the diffusion of taste substances to taste receptors, the chemical interaction with food substances, and protects taste buds. When examining the relationship between the rate of salivary flow and the taste threshold, we found that the rate of salivary secretion was lower than the standard level (10mL/10min) in all subjects with gustatory impairment but normal in subjects with normal taste thresholds. These data indicate that hyposalivation is closely related to hypogeusia. Clinical studies have shown that hypogeusia improves by treating hyposalivation, indicating that salivation is essential for normal taste function. The umami compound glutamate was able to increase saliva and thereby improve hypogeusia by enhancing the gustatory-salivary reflex. Our data demonstrates that umami compounds are an effective tool for the relief of hypogeusia without any side effects. In conclusion, our work has proven that since taste function and overall health are associated, salivation and health are also indirectly related.

Keywords: umami taste, hypogueusia, hyposalivation, elderly, healt

SY(T5)11-02

The Mediterranean diet effects on health outcomes

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The traditional Mediterranean diet (MedDiet) is defined as the staple food pattern consumed in the early 1960s in Greece, Southern Italy, Spain, and other olive-growing countries of the Mediterranean basin. This frugal diet uses generous amounts of olive oil as main culinary fat and includes a high consumption of plant-derived foods (fruit, vegetables, legumes, nuts and seeds, and whole grain cereals) and fish/seafood; frequent but moderate intake of wine (especially red wine), usually accompanying meals; moderate consumption of dairy products (especially yogurt and cheese, but not butter or cream), poultry and eggs; and low consumption of sweetened desserts or red and ultra-processed meats. Since 16th November 2010, the MedDiet was inscribed into UNESCO's Representative List of Intangible Cultural Heritage of Humanity.The conventional nutritional composition of the MedDiet model provides sufficient fiber, whole grains and starchy vegetables, higher amount of plant-based protein, high quality of the lipid profile (mono- and polyunsaturated fatty acids), and plenty of vitamins, minerals, antioxidants and phenolic compounds such as hydroxytyrosol, tyrosol, and β-sitosterol, which are recognized as main actors in the protection against chronic disease through the modulation of some intermediate metabolic pathways.A huge accrual of worldwide large observational epidemiological evidence has shown that the MedDiet is associated not only with a reduced risk of major chronic disease, but also with health maintenance and illness prevention. An umbrella review concerning the association between MedDiet adherence and multiple health outcomes appraised 13 meta-analyses of observational studies and 16 meta-analyses of RCTs investigating the association of MedDiet with 37 different health outcomes, for a total population of over than 12, 800,000 subjects, which enabled to feature diverse MedDiet and health interactions. Thus, robust evidence was found to support the effects of a higher MedDiet adherence on reduced risks of overall mortality, related-cardiovascular diseases, overall cancer incidence, neurodegenerative diseases and diabetes. Notably, 2 large Spanish RCTs, the PREDIMED trial (n=7,447) for primary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

prevention and the CORDIOPREV (n=1,002) trial for secondary prevention used hard clinical endpoints found substantial cardiovascular benefits, with relative reductions in major events. Most MedDiet's beneficial effects could be primarily related to anti-inflammatory and antioxidant properties, improvements in insulin sensitivity and endothelial function, anti-clotting properties in addition to interacting with epigenetic mechanisms and gene expression that modify disease risk as well as reducing adiposity and metabolic syndrome manifestations. Furthermore, other benefits related to the long-term adherence to the MedDiet include better quality of life or healthy aging, improved cognition and reductions in the rates of dementia, depression, respiratory diseases, and frailty fractures. Noteworthy, the MedDiet is ecologically sustainable, showing a reduced environmental impact, thus representing another important positive aspect of this dietary model. Further to encourage health and sustainability, MedDiet have additional social, satisfactory/satiety, security, and safety dimensions, which may be shared with other dietary pattern such as Japanese diet.

Keywords: Mediterranean diet, Health, Nutritional patterns, Quality of life, Wellbeing

SY(T5)11-03

Keeping the tradition of healthy Mediterranean ingredients together with culinary innovation

Josep Barahona Vines[1]

1. L'estudi (Japan)

The Spanish Chef Josep Barahona started with a Mediterranean restaurant, but his long career in Japan has influenced his process of innovation. He will share his experiences and how they have defined the kind of chef he has become and how the elements of the Japanese cuisine influenced his cooking.

Keywords: Mediterranean cuisine, cooking, chef, umami, healthy diets

SY(T5)11-04

The Washoku concept in the Mediterranean diet

Chikara Yamada[1]

1. (Restaurant) Yamada Chikara (Japan)

From his Japanese perspective, who has also experienced other cuisines and ingredients, including the Mediterranean gastronomy, the chef Chikara Yamada will share the major experiences that have made him the kind of chef he is and what drove him to focus on the Japanese cuisine after his return to Japan.

Keywords: Chef, Mediterranean, washoku, cuisine, restaurant

SY(T6)1-01

Integrated programming reduces malnutrition, builds strong families, and reinforces social cohesion in Mali

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1. Save the Children (Morocco)

Background and Objectives: In Sikasso, Mali, inadequate consumption of nutritious foods, abnormal loss of nutrients due to illness, and harmful social norms contribute to undernutrition. To improve the nutritional status of children and pregnant and lactating women, the USAID-funded Project Nutrition et Hygiène [USAID/PNH] supported an integrated approach across the health/nutrition, agriculture, and water, sanitation, and hygiene [WASH] sectors by empowering gender transformative community groups to promote small doable maternal and child nutrition and WASH practices at the household level in six health districts in Sikasso Region.

Methods: Community Nutrition Groups [GSANs] facilitate behavior change sessions to help caregivers improve household nutrition and hygiene practices. GSANs, led by female change agents known as Maman Leaders [MLs], collaborate with WASH committees to reinforce links between hygiene and nutrition. MLs negotiate with family members to adopt small doable actions that will lead to better nutrition and fewer cases of illness, while WASH committees work with community members to construct latrines and handwashing stations, and farm field schools [FFS] teach women farmers how to increase yields of nutrient-rich foods. A mid-term evaluation using household survey and program data was conducted to document progress in nutrition and WASH outcomes due to USAID/PNH's multi-sectoral and community approaches and interventions.

Results: The proportion of children below two years who are underweight dropped by 27% from the baseline and wasting in

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

children aged 0-23 months declined by 41%. Community activities have contributed to improved IYCF practices, with exclusive breastfeeding increasing from 35% to 64%. Children aged 6-23 months eating four+ food groups increased from 13% at baseline to 57%. Access to and information on more nutritious foods during community-wide cooking demonstrations, GSAN sessions, and FFS meetings may be having an impact on what people are eating.

Conclusions: USAID/PNH's integrated WASH, nutrition, and agriculture interventions and coordinated gender transformative community platforms have yielded results that positively influence nutritional status in project-supported communities. Because community platforms apply SBC techniques, such as interpersonal communication and hands-on skills building sessions, while working in concert with WASH and agricultural supply chain platforms, they effect greater longstanding change at the community level.

This publication was made possible through support provided by U.S. Agency for International Development. The opinions expressed herein are those of Save the Children and do not necessarily reflect the views of the U.S. Agency for International Development.

Keywords: Integration, SBC, IYCF, Coordination, Gender

Conflict of Interest Disclosure: This publication was made possible through support provided by U.S. Agency for International Development. The opinions expressed herein are those of Save the Children and do not necessarily reflect the views of the U.S. Agency for International Development.

SY(T6)1-02

Impact of Enhanced Community Conversations to improve nutrition practices in Ethiopia

Habtamu Fekadu[1], Lioul Berhanu[2], Daniel Abbot[2]

1. Save the Children (USA), 2. Save the Children (Ethiopia)

Background and Objectives: Save the Children, through USAID Growth through Nutrition project, implemented Enhanced Community Conversations (ECCs) to improve maternal dietary and infant and young child feeding (IYCF) practices. ECCs are peer support groups comprised of mothers, fathers, or grandmothers of children under two who meet regularly for ten sessions. Each session covers specific topics that go beyond raising awareness, focusing on promoting the adoption of nutrition-related skills, behaviors, and gender transformative roles during the first 1,000 days. ECCs use a package of multimedia social and behavior change communication (SBCC) materials, including virtual facilitator (VF), games, roleplays and take-home materials to facilitate discussion and learning during the sessions and action afterwards.

We implemented ECCs using two facilitation approaches: 1) frontline health and agriculture workers without a VF, and 2) community change agents (CCAs) recruited from the community by local NGOs, complemented by a VF. The VFs are audio recordings of professional voice actors playing the roles of relatable characters.

Growth through Nutrition conducted an operational research study led by Tufts University to assess the impact of the two ECC approaches and the value added by the VF on IYCF and maternal nutrition practices and the nutritional status of women and children in Ethiopia.

Methods: The project used a quasi-experimental design with a control group in three districts where the project was implemented. In each district, two sub-districts were selected, one to receive ECCs with VF (intervention), and one without VF (control). The control group participants received 10 monthly ECC meetings led by CCAs, take-home materials for action at home, and follow-up household (HH) visits. The intervention group received the same package, with the addition of the VF audio component. The project collected baseline data in December 2018 before the ECCs began and an endline in November 2019 after the completion of 10 ECC sessions. The surveys measured significant differences within groups with a chi-square test and used a difference-in-difference analysis to assess changes between the groups.

Results: ECCs, both with and without VF, resulted in significant improvements in nutrition practices. The percentage of children meeting minimum diet diversity improved from 10.2% to 31.3% (control) and 12.2% to 37.5% (intervention) and minimum acceptable diet increased from 6.1% to 26.9% (control) and 5.6% to 26.8% (intervention). Women with appropriate diet diversity improved from 22.9% to 31.0% (control) and from 22.0% to 37.9% (intervention). The project observed a positive change in the consumption of food groups in line with the promotion of a nutrient-dense and diverse diet. The added value of the VF was assessed, and compared to ECCs without VF, those with VF showed statistically significant improvements in Iron Folic Acid (IFA) intake for more than three months.

Conclusions: ECCs led to improvements in nutrition related behaviors. ECCs without VF were effective and have good potential for frontline workers to take to scale, while ECCs with VF have an added value and can be implemented where operationally feasible. The project has refined this approach to support scalability and sustainability through government systems.

Keywords: IYCF, Behavior Change, Diet Diversity, Enhanced Community Conversations

Further Collaborators: The project's Enhanced Community Conversation approach was developed with technical leadership from The Manoff Group

SY(T6)1-03

Field experience around designing adolescent nutrition programming in Ethiopia and Laos

Wossen Assefa Negash[1], Carolyn O'Donnell[2]

1. Results for Development (R4D) (Ethiopia), 2. Save the Children (USA)

Background and objectives: USAID's Growth through Nutrition project in Ethiopia and the USAID Nurture project in Laos were implemented by Save the Children to improve nutrition outcomes among adolescents. In Ethiopia, formative research supported the development of a "whole-household" strategy, which prioritized household members most vulnerable to undernutrition, including adolescents. In Laos, formative research found that a lack of household understanding of the importance of adolescent nutrition perpetuated insufficient quantity and diversity in adolescent girls' diets.

Methods: In Ethiopia, Growth through Nutrition developed adolescent-friendly multi-media materials on optimum adolescent nutrition actions and delivered them through in-school and out of school platforms. Adolescents acted as change agents and shared nutrition information from school with their parents. The project also integrated nutrition promotion activities with existing government systems to ensure sustainability. In Laos, USAID Nurture trained community volunteers to promote ten Small Doable Actions (SDAs) to improve nutrition and WASH behaviors among 1,000 Days Households and those with adolescent girls. USAID Nurture also collaborated with the Ministry of Health to strengthen nutrition counseling in MNCH services, including adolescent nutrition counseling and youth-friendly approaches.

Results: The project reached 301,800 adolescents through in-school and out of school initiatives. Nutrition messages were disseminated through 12 government educational radio stations with a total reach of more than 14 million students. Through home visits and community-wide events, USAID Nurture reached over 6,000 adolescent girls to promote SDAs. The project also supported the training of 126 health workers on adolescent nutrition counseling.

Conclusions: As adolescent nutrition is a relatively new frontier, concepts and approaches need to be constantly tested and adapted to improve program quality.

Formative research is critical to identify the specific barriers to adolescent nutrition in a given context and develop effective SBC approaches.

-Positioning nutrition as a "family affair" resonated well with adolescents, families, and stakeholders.

-Adolescents can change nutrition practices for their entire family.

-Integrating interventions with existing education, health, and agriculture systems helped ensure cost-effectiveness, scalability, and sustainability.

-It is important to address adolescent nutrition at home, in health services, and in schools through capacity strengthening for improved and adolescent responsive counseling.

This publication was made possible through support provided by U.S. Agency for International Development. The opinions expressed herein are those of Save the Children and do not necessarily reflect the views of the U.S. Agency for International Development.

Keywords: Whole household approach

SY(T6)1-04

Innovations in enriching complementary food help diversify diets in Cambodia

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1. Save the Children (USA)

Background & Objective: To prevent stunting and give every child a healthy start, children 6-23 months of age need a diverse diet, including daily animal source food. Fish, especially when the head and bones are included, contain most nutrients needed for optimal child growth and development. Although small fish are a staple in Cambodian diets and are available much of the year, only half of children 6-23 months from poor rural communities eat fish due to fears of choking and the time required to cook for children.

Methods: The USAID-funded NOURISH project developed a simple solution by teaching families to make small fish powder [SFP], which could be easily added to any family food. NOURISH worked with food scientists at two regional universities to test its safety, shelf life, and nutritional content and to conduct routine quality control checks. They taught pregnant women and caregivers of children under five years from 475 villages in Cambodia to make SFP at home and coached women entrepreneurs to produce and sell SFP through informal, local markets. This activity was layered on the project's comprehensive social behavior change [SBC] campaign, which promoted 13 key stunting prevention behaviors, including the importance of diet diversity for optimal nutrition and growth, through various communication channels and platforms. Effectiveness of the intervention was measured through routine project monitoring of household SFP production while nutrition outcomes were measured through the project's endline evaluation household survey.

Results: Consumption of small fish/SFP increased from 61% at baseline to 72% at endline, with steady increases as children aged. At endline, among children who had consumed SFP, 81% had minimum diet diversity [MDD] and 80% had minimum acceptable diet [MAD], compared to 19% and 65%, respectively, among children who had not consumed SFP. This increase was also a contributing factor to the 25% increase in MAD.

Keywords: diet diversity, home fortification, fish powder

Conclusion: Promoting small fish powder as a practical activity within a broader SBC campaign in an environment where fish are accessible is a simple and sustainable solution to improve children's nutrition practices, especially diet diversity, which can be layered onto a variety of SBC programs in similar contexts with high potential for impact.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)2-02

Age distribution of all-cause mortality among children younger than 5 years – possible implications for VAS programs

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1. Helen Keller International (USA), 2. UNICEF HQ (USA)

Coverage of essential child health and nutrition interventions in low- and middle-income countries remains suboptimal. Adverse exposures, such as undernutrition and infections, are particularly harmful during the 1000 days from conception until 2 years of age.

In a cross-sectional study of just under three million children under five years of age in 77 countries we explored whether deaths are concentrated in the first 2 years after birth. A synthetic cohort probability method was used drawing on data from Demographic and Health Surveys and Multiple Indicator Cluster Surveys from 77 low- and middle-income countries surveyed from March 2010 to December 2019. Participants included children younger than 5 years at any point 10 years before survey.

In the pooled sample, 81.5% (95% CI, 81.0%-82.0%) of deaths occurred in the first 2 years after birth—43.0% (95% CI, 42.4%-43.7%) in the neonatal period—ranging from 63.7% (95% CI, 61.6%-65.7%) in Niger to 97.8% (95% CI, 85.9%-99.7%) in Albania. An estimated 18.5% (95% CI, 18.0%-19.0%) of child deaths occurred at 24 to 59 months of age. Countries with higher mortality rates among children younger than 5 years had a lower share of deaths occurring in the neonatal period.

Previous research has highlighted perinatal complications, infections, and undernutrition as primary causes of death among children younger than 5 years. The results of this analysis suggest that coverage of interventions to reduce these adverse exposures should be prioritized during pregnancy and the first 2 years after birth, which is also a crucial period for human development.

Keywords: Child mortality, Adverse exposures, Prioritization

Further Collaborators: Victor Aguayo, Grainne Moloney, Annette Imohe

SY(T6)2-03

Operationalizing: targeting children under 2 with VAS in Senegal as a phased approach to health systems strengthening

Banda Ndiaye[1], Alison Greig[1], Emily Measures[1], Caitlin Gomez[1], Amadou Ndiaye[1]

1. Nutrition International (Senegal)

Objective: Ensure yearly 2 doses VAS coverage is maintained to at least 80% through PHC routine delivery platforms and Improving accessibility and availability of essential child nutrition and health services like Growth Monitoring Promotion, nutrition education, screening for acute malnutrition, diarrhea treatment with zinc and Lo_ORS and catching up for missed essential vaccinations.

Justifications: Decreased funding and opportunities for integration of VAS into immunization campaigns leading to unprecedent slippage of VAS coverage especially in Sub Saharan Africa.

Methods: Assessing the readiness of the national PHC system to deliver VAS to children 6 to 59 months old through the routine PHC contacts and use findings to develop informed plan, guidelines, and tools for implementation of VAS through the routine PHC services. Support to stepwise implementation of the plan including partnering with other nutrition support programs to strength the capacity of the PHC system to deliver integrated nutrition services package including VAS. Regular reviews of progress to identify key challenges and bottlenecks at Primary health care unit (PHCU), districts, regional and national levels for corrective decision making.

Results: high coverage in 6 to 11 months old children throughout the country contrasting to low coverage in children 12 to 59 months old. Districts and PHCU implementing the plan as per operational guidelines including reinforcing community platforms have been successfully reaching over 80% in both age group children.

Conclusions: There is real potential for reaching over 80% VAS coverage in both 6-11m and 12-59m old children and focus should be on ensuring fidelity implementation as per operational guidelines through effective program monitoring and review for quality data driven corrective actions including identification of platforms that can efficiently reach specific age groups.

Keywords: Child mortality, Adverse exposures, Prioritization

SY(T6)2-05

Vitamin A data that are needed to assess deficiency and excess in order to better target vitamin A supplementation programs

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Background: Vitamin A (VA) supplementation (VAS) programs prevent child mortality in populations where VA deficiency (VAD) remains a public health problem. To improve status, VA fortification has been mandated in many countries but reaching young children with sufficient VA can be challenging. Before revising VAS policies, confirmation of adequate VA status and sustained intake are required, among other factors. This presentation describes different methods to assess VA status and how these have been used in different national surveys to drive decisions.

Methods: High under-5 mortality rate (U5MR), symptoms of xerophthalmia and low serum retinol concentrations (SRC) in the population were sufficient evidence to recommend VAS. Other biomarkers to assess VA status exist and are in current use. More recently, retinol binding protein (RBP) has been used to estimate VAD. The modified relative dose response (MRDR) test is more sensitive to total liver VA reserves than ocular signs, SRC, or RBP. MRDR has been used in Nepal, Guatemala, and Malawi, among others, in their national micronutrient surveys (NMS). Fasting circulating serum retinyl ester concentrations can be used with the MRDR test when potential VA excess exists; this was applied in Malawi. Retinol isotope dilution (RID) works along the continuum of VA status but has not been employed in NMS. Nonetheless, RID was applied in a South African cohort study to inform the presence of high circulating retinyl ester concentrations in a population suspected of high intake of VA. Dietary intake data informs VA biomarker results and provide assurances that VA status is not transient. Evaluating actual dietary intake, food frequency of specific foods, including fortified products, and modeling of household expenditure/income data are useful.

Results: Xerophthalmia is rare due to successful programs and general health improvements. Adding the MRDR test to surveys better defines liver VA reserve adequacy. Nepal determined VAD was no longer a public health problem using MRDR in a subsample. However, the seasonality of VA-rich foods suggests that VAS may still be necessary to maintain adequate status. Based on SRC, RBP, MRDR, and sugar fortification quality, Guatemala has chosen to target VAS to younger children. The triangulation of MRDR, serum retinyl esters, and serum carotenoids suggest VA programs are effective in Malawi, yet more targeted evaluation of dietary data is needed before VAS policy will be revised. In South Africa, RID, serum retinyl esters, and liver frequency data suggested no VA deficiency and evidence of excessive liver reserves. Evaluation of VAS policies is on-going.

Keywords: biomarkers, hypervitaminosis A, night blindness, retinyl esters, xerophthalmia

Conclusions: Population data using sensitive VA biomarkers and dietary intake data are needed before VAS can be better targeted to those in need.

Conflict of Interest Disclosure: No conflicts of interest with vitamin A supplementation programs.

SY(T6)3-01

Impacts of ultra-processed foods on health and environment: the scientific evidence

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The nutrition literature and authoritative reports increasingly recognise the concept of ultra-processed foods as a descriptor of unhealthy diets. Ultra-processed foods are defined by the NOVA system as formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes. These foods have novel physical structures and chemical compositions that have been identified as providing plausible biological mechanisms to explain associations between ultra-processed foods and adverse health outcomes. At the same time, their production wastes scarce environmental resources which could be used to produce healthy foods. Understanding of the contribution of ultra-processed foods to dietary quality, diet-related diseases and environmental degradation is needed to inform strategies aiming to improve population and planetary health. This presentation will explore the body of scientific evidence on the impacts of ultra-processed foods on health and environment across a range of study designs, populations and country contexts. The range of outcomes, the mechanisms underlying these associations and recommendations for further research will also be explored.

Keywords: Ultra-processed foods, Health, Non-communicable diseases, Environment, Sustainability

SY(T6)3-02

Understanding the global rise of ultra-processed foods: the food systems and commercial determinants

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Background: Food processing has played an important role in human evolution and the birth of civilizations, in the development of cuisines and food cultures, and in making food safer, more palatable and durable. However, only in recent decades have ultra-processed foods become prominent in human diets, representing a major divergence from dietary patterns of the past. Understanding the determinants of changing ultra-processed food (UPF) consumption is essential, given mounting evidence linking such foods with adverse health and environmental outcomes. It is crucial to informing worldwide food policy responses by governments. Using a food systems approach, this presentation reports the results of a study on trends, dynamics and determinants of worldwide UPF consumption.

Methods: This study adopted a synthesis review method, involving two steps. First, quantification of per capita volumes and trends in UPF sales, and ingredients (sweeteners, fats, sodium, cosmetic additives) supplied by these foods, in countries classified by income and region. Second, a review of the literature on the food systems, commercial and political economy factors that may explain the observed changes in UPF consumption, and differences between regions and countries.

Results: In recent decades, there has been a substantial expansion in the types and quantities of UPFs sold worldwide, representing a transition towards a more highly-processed global human diet, but with significant variations between regions and countries at similar levels of economic development. Sales volumes are highest in Australasia, North America, Europe and Latin America, but are growing most rapidly in Asia, the Middle East and Africa. As countries grow richer and increasingly urbanized, more UPFs and a wider variety of UPFs are sold. These developments are closely linked with food systems transformations at global, national and sub-national levels. This includes the industrialisation of food systems, including the rising production of cheap agricultural input commodities, and technological changes in food production, manufacturing and marketing. Globalization is a key underlying driver, including growth in the marketing and political activities of transnational food corporations, the growing power of financial actors in the food system, and inadequate governance and policy responses by governments.

Conclusions: The scale of dietary change underway, especially in highly-populated middle-income countries, raises serious concern for global nutrition, public health and the environment. The global rise of UPFs reflects major transformations in food systems, including many changes linked with the commercial activities of transnational food corporations, and policy responses that are inadequate in both strength and scope. Responding to this challenge will therefore require a whole of food systems approach, including actions to strengthen the implementation of policy frameworks that attenuate the commercial determinants of the problem.

Keywords: Nutrition transition, Ultra-processed foods, Food systems, Commercial determinants, Transnational corporations

SY(T6)3-03

The social and cultural factors associated to ultra-processed dietary patterns

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Ultra-processed foods are formulation of refined substances and additives used to create products that are ready-to-eat, highly palatable, convenient, and cheap. In the last decades, these products have dominated the market in high income countries, and their sales are now growing rapidly in low- and middle-income countries. Epidemiological research has shown that diets high in ultra-processed products are associated to poor diet quality, and several adverse health outcomes. All around the world, diets based on traditional foods and meals are replaced by diets dominated by ultra-processed products with a sharp increase in obesity, chronic diseases and all-cause of mortality. However, less attention has been given to the social and cultural factors associated to ultra-processed dietary patterns. Drawing from studies in anthropology and sociology, as well as some preliminary data on ultra-processed food consumption in Canada and in the world, I will argue that food and ultra-processed food are categories associated to distinct food cultures, with important consequence on health. Food is culture and plays a fundamental role in shaping social norms, values, and beliefs. Indigenous food studies have revealed that the loss of traditional foods impact social cohesion, social relationships, and mental health. We are what we eat, and we also eat what we are. However, if food is culture, then what are ultra-processed products? In this presentation, I will discuss the specific characteristics shared by ultra-processed products and explain how they may negatively affect people's behavior and relationships to food. I will link those characteristics to distinct food cultures and discuss their impact on health. To address the current nutrition transition, I argue that we need to consider the social and cultural implications of ultra-processed dietary patterns. Policies are needed to protect and cherish fresh and minimally processed foods that are traditional and culturally relevant to communities, because beyond their nutritional value those foods have a cultural value that must be consider in public health policies and interventions.

Keywords: Ultra-processed foods, Food and nutrition policy, Food culture, Traditional foods

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)3-04

Policy and regulatory reforms to target ultra-processed foods

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Ultra-processed foods (UPFs) are associated with a range of adverse population and planetary health outcomes. The availability and consumption of these foods are rising around the world as food systems undergo rapid transitions. This increasing availability and consumption of UPFs is occurring despite investment in food and nutrition policy and regulatory systems designed to protect (and promote) public health. How can this be?

This presentation will report the findings of a critical analysis of food and nutrition policy and regulatory system activities in relation to UPFs and propose reforms to help inform the development of 'fit-for-purpose' policies and regulations to target ultra-processed foods.

The critical analysis of food regulatory system activities focused on the nature and scope of their risk analysis frameworks. Consistently, food regulatory systems frame risk assessment disproportionately in terms of toxicological and microbiological risks with limited regard to public health nutrition risks. When nutrition risks are considered the assessment processes generally use methods which are not well-suited for specifying and measuring contemporary risks of the types associated with UPFs. Findings from the critical analysis were used to identify reforms to risk analysis frameworks so they are fit-for-purpose for assessing risks associated with UPFs.

The critical analysis of food and nutrition policy frameworks focused on the scope of policy reference standards such as dietary guidelines and policy actions such as front of pack labelling. Consistently, the scope of these policy activities is framed in a reductionist orientation which privileges nutrient exposures over food exposures as the focus of policy activities. For example, currently the design of front-of-pack labelling is being informed predominantly by nutrient profiling systems which inadvertently are providing 'health halos' for UPFs. Findings from the critical analysis were used to identify reforms to the nature and scope of the evidence synthesis and translation methods used to inform nutrition policy activities so they are fit-for-purpose for attenuating UPF harms.

Reforms to monitoring and evaluation activities so they provide information which is fit-for-purpose to guide food and nutrition policies and regulations to target UPFs are also proposed. These reforms are focussed on the processes for compiling and reporting on food composition and food consumption databases.

Keywords: Ultra-processed foods, Food and nutrition policy, Food regulation, Risk assessment, Monitoring and evaluation

Further Collaborators Acknowledgement: Lawrence M, Baker P, Worsley A, McNaughton S. Reforming evidence synthesis and translation for food and nutrition policy. Australian Research Council Discovery Project; DP190101323

I am a member of the Food Standards Australia New Zealand (FSANZ) Board, the views I present are not necessarily those of the FSANZ Board. I alone am responsible for the views expressed in this presentation.

SY(T6)4-01

Who should think and what should be done to achieve a healthy diet for humans and the planet

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The world is in the midst of a transition from undernutrition to overnutrition. This process requires more efficient and sustainable approaches to address double or triple burden of malnutrition. The year 2021 is an important year for the global trend in nutrition. It marked the midpoint of the UN Decade for Nutrition, the UN Food Summit in September, and the Tokyo Nutrition for Growth (N4G) Summit in December. Sustainable healthy diets were discussed in this series of events. Japan has a unique experience in nutrition that can be shared with the world. Japan has dealt with "nutritional deficiencies" due to food shortages and "lifestyle-related diseases" associated with rapid economic growth. Japan has developed nutrition policies to meet the challenges of each era and has become the world's longest-lived nation by practicing a healthy diet in addition to achieving universal health coverage. It has also lowered the prevalence of obesity. Japanese food is listed as one of the territorial diets rooted in the region, and it has an essential double duty to support not only the health benefits but also the transition to sustainable agriculture and food system. We used the EAT-Lancet Diet model to examine the sustainable healthy diet achievement of the Japanese diet using data from the Japan National Health and Nutrition Survey. The results indicated that the Japanese diet almost achieved a sustainable healthy diet, although excessive consumption of red meat was problematic in terms of the EAT-Lancet Diet. In most countries and regions of the world, rapid socioeconomic development has accelerated attractive and convenient food choices. For example, efforts are being made to prevent overnutrition and noncommunicable diseases especially in the Pacific Islands. Diet in small island countries are vulnerable to natural conditions caused by climate change or socioeconomic conditions. The Japan International Cooperation Agency (JICA) is cooperating with low- and middle-income countries facing a double or triple burden of malnutrition to help them achieve a healthy diet, including the capacity development of nutrition experts, policy development, or school meal programs. Stakeholders involved in the supply chain must shift from a one-way food system based on market norms to a people-centered food system based on social norms, where no one is left behind to be healthy in every corner of the world. It is not feasible for a single sector/stakeholder and needs to be a multi-sector/stakeholder effort.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Sustainable Healthy Diet, double burden of malnutrition, triple burden of malnutrition, social norms, food systems

SY(T6)4-02

Equitable and ethical diets for sustainable food systems

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In the context of the broad global trends of population growth, the climate crisis, and inequitable diets, food systems need to be re-oriented to ensure they can produce enough food that nourishes everyone, leaving no one behind. At the same time, food systems must decrease the pressure on biodiversity loss, conserve land and water resources, minimize air and water pollution, and lower greenhouse gas emissions. The current COVID-19 pandemic has imposed additional pressures on the governance, functionality, efficiency, and resilience of food systems, with potentially long-lasting implications. This re-orientation includes moving towards on-farm sustainable food production practices, lessening food loss and waste, addressing poverty by creating jobs and decent livelihoods, and providing safe, affordable, and healthy diets for everyone. This is a lot to ask of an already entrenched system involving diverse actors with diverging priorities and motivations. Sound food policies are central to changing systems, and bold policies must be applied to accelerate and incentivize economic, societal, and technological transformations towards a more socially just and sustainable global food system. But policy decisions come with trade-offs and ethical challenges, and short- and long-term, often unexpected consequences. In a world of uncertainty, can we have both human and planetary health—can we have it all? This presentation will explore that question through a global lens that takes the audience through a range of sticky debates that plague the world's ability to ensure equitable and ethical diets for everyone.

Keywords: ethics, diets, sustainable, food systems, trade-offs

SY(T6)4-03

The combination of tropical agriculture and insect use for food

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Insects have been eaten as food from temperate to tropical regions except for Islamic cultures in a long tradition. In recent years, insects have attracted attention as a future food source. Various species of traditional edible insects can be collected through agricultural and rural life. These traditional edible insects have a connection between diverse natural environments and diverse food choices depending on peoples' livelihoods. The amount weights of insects consumed and the labor costs of collecting insects indicate that insects can be a substantial part of the diet among tropical peoples throughout the year. Insects are one of the ingredients that spice up the diets and help in the balance of micro nutrient intake such as Cu, Fe, and Zn. This presentation describes insect food as one of the various uses of natural resources in local subsistence strategies and cultural adaptations and evaluates its value as micro-nutrient resource. Case studies based on geographic and cultural ecological field surveys in which food safety and food security are crucial issues include termite consumption and crop raising on termite hills in Southern Africa (South Africa, Zimbabwe), edible insects associated with rice cultivation in Southeast Asia (Laos, Thailand), and edible forest insects associated with sago palm cultivation in Oceania (Papua New Guinea); health and nutritional transition were crucial issues. Agricultural land is greatly involved in the acquisition of edible insects depending on the growth of crops and the usage of agricultural land. Wild edible insect use can be integrated in agriculture such as growing crops on termite mounds and using the termites as food as well as managing pest insects by collecting them for food. It is necessary to understand the use of insects in the diet by understanding the interrelationship of human activities and insect habitats. In natural resource-dependent societies, the natural resources such as wild leaves, animals, and insects have been suppliers of micronutrients for a long period of time. Therefore, it is necessary to evaluate adaptive aspects of local diets and subsistence activities that provides micronutrients. The relationship among health, nutritional status, diet and natural food resources was elucidated in different ecological settings. Effectiveness for health by micro-nutrients is regarded in the hypothesis of intake of miscellaneous wild food materials such as insects collected by subsistence activities nearby for daily food.

Keywords: Edible insect, micro-nutrient, subsistence activity, Cultural ecology, Geography

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)4-04

The environmental cost of protein food choices

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Background and Objective: Climate change is emerging as a major challenge of the 21st century. Agriculture both affects and is affected by climate change, yet agriculture and food production has been largely overlooked in discussions on climate change policy. A new paradigm is needed for sustainable food system development and climate change mitigation. The objective of this study was to investigate the environmental impact of producing one kilogram (kg) of edible protein from two plant and three animal protein sources.

Methods: Primary source data were collected and applied to commodity production statistics to calculate the indices to compare the environmental impact of producing 1 kg of edible protein from beans, almonds, eggs, chicken and beef. Inputs included land and water for raising animals and growing animal feed, total fuel, and, total fertilizer and pesticide for growing the plant commodities and animal feed. Animal waste generated was computed for the animal commodities.

Results: To produce 1kg of protein from beans required approximately 18 times less land, 10 times less water, 9 times less fuel, 12 times less fertilizer, and 10 times less pesticides in comparison to producing 1kg of protein from beef. Compared to producing 1 kg of protein from chicken and eggs, beef generated 5 to 6 times more waste (manure) to produce 1kg of protein.

Conclusions: The substitution of beef with beans in meal patterns will significantly reduce the environmental footprint worldwide and should also be encouraged to reduce the prevalence of non-communicable chronic diseases. Societies must work together to change the perception that red meat (e.g., beef) is the mainstay of an affluent and healthy diet.

Keywords: Resource efficiency, Sustainable agriculture, Animal protein, Plant protein

SY(T6)5-01

Poverty and Obesity

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Background and objectives: Obesity in the US follows a socioeconomic gradient. Obesity is more common in more deprived areas and among lower- income groups.

Methods: Although links between prevalent obesity and multiple aspects of the built environment are observed in cross-sectional studies, recent studies of movers show that the built environment has little influence on weight gain over time. Studies on nutrition economics likewise show that food expenditures vary with residential location and socioeconomic status.

Results: Paradoxically, the so-called "obesogenic" neighborhoods do not promote weight gain and have no obesogenic power. Rather, the observed spatial clustering of obesity by neighborhood may be related to residential property values, as opposed to the geographic distribution of supermarkets, fast foods, public transport, or opportunities for physical activity. In essence, obesity is one embodiment of social and economic deprivation. There are further links between obesity, diet quality, and diet cost. In general, diets composed on refined grains, added sugars and fats cost less per 2000 kcal than do healthier diets composed of minimally processed meat and fish, whole grains and fresh vegetables and fruit. Budget driven dietary choices can have physiological consequences. Some lower-cost processed foods that are both energy dense and palatable can promote overeating and subsequent weight gain. Estimated diet cost has also been linked to residential property values and diet quality does vary across neighborhoods.

Conclusions: The long-standing socio-economic disparities in obesity prevalence were brought into sharp relief by the COVID-19 pandemic. The recent rise in food prices was most marked for nutrient-rich foods, including meat, fish and dairy. The reliance of low cost foods of minimal nutritional value, coupled with sedentary lifestyles, will lead to a sharp increase in obesity rates among vulnerable children and adults for years to come.

Keywords: Obesity, Diet quality, Deprivation, Poverty, Property values

SY(T6)5-02

Effects of socioeconomic status on nutrition and nutrition policy studies in Asia

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Evidence of health disparities has been reported around the world. One of the intermediate factors between socioeconomic status (SES) and health is nutrition. Many studies reported socioeconomically disadvantaged people had more risk of obesity and NCDs than others in western society. In Asia, on the other hand, the economic status of countries is diverse, ranging from low-income to high-income countries, and furthermore, economic status is changing. Therefore, the relationship between SES and nutrition is also considered to be different and changing from country to country. In studies since 2010, the nutritional status of populations with low SES is as follows. In India, undernutrition among children and women has been reported. In China, low energy and nutrient intake and undernutrition are common among children and elderlies, while adults have both obesity and undernutrition. In Japan and Korea, weight faltering of preschool children, low dietary quality among school children to adults, and high obesity among adolescents and adult women have been reported. There are two types of

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

policies to reduce nutrition disparities: those that address the population as a whole and those that focus on households with low SES. For population-wide measures, school environmental interventions have been reported to reduce economic disparities in childhood obesity in high-income countries. It has also been reported that school lunches contribute to improved nutritional status of children in low- and middle-income countries, that school lunches reduce economic disparities in children's dietary quality and that there are no economic disparities in obesity among school children in Japan. As for interventions for low SES households, Supplemental Nutrition Assistance Program (SNAP) in the United States is famous. Several types of intervention to improve the nutritional status of low SES households in low- and middle-income countries were reported. Intervention that improved buying power: unconditional cash transfer (UCT), conditional cash transfer (CCT), income generation intervention, interventions that addressed food prices: food vouchers, food and nutrition subsidies, intervention that addressed the social environment: social support interventions. In India, in addition to CCT by the government, the effectiveness of microfinance by NGOs is also being examined. In China, there are reports on the effectiveness of government-sponsored CCT and the Rural Pension Scheme for the elderly. In South Korea, there are reports on the effects of government food assistance and nutrition education for mothers and children, and food assistance for the elderly. In Japan, there are food banks and home-delivered meals for children provided by NPOs, etc., but there are few policies by the government. Nutrition disparities due to SES disparities in Asia need to be monitored. In Asia, nutrition policy focuses on cash subsidies and food assistance for low SES households, but food environment measures for the population as a whole, such as school lunches, are also needed to reduce not only undernutrition but also overweight/obesity.

Keywords: Socioeconomic status, Nutrition disparities, Nutrition policy, Asia

SY(T6)5-03

Achieving an equitable healthy society through data-driven community organizing

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Health and health behaviors are influenced by macro-level factors (e.g., national policies, food systems, income inequality, etc.) and the individual social factors that come from them (e.g., social relationships, participation, income, occupation, neighborhood environment, etc.). Interventions to these social factors are therefore essential. In particular, changing the social environment in a community or a country requires community organizing in collaboration with various non-health sectors, not just medical and health professionals. In addition, in order for diverse organizations to work together, goal setting and evaluation of achievement must be done with objective data. The presenter, a social epidemiologist, will use examples from the Japan Gerontological Evaluation Study Initiative, the collaborative research project with about 60 municipalities across Japan (Haseda et al, Soc Sci Med, 2019; Health Place, 2022), and social experiments we conducted in Adachi Ward, Tokyo (Nagatomo et al, Int J Behav Nutr Phys Act, 2019) and some others, to show how data-driven community organizing strategies can change individual health behaviors, including diet and its equity.

Keywords: health equity, social epidemiology, social determinants of health, community organizing, behavioral sciences

SY(T6)5-04

Children's Healthy Living community randomized trial sustainably decreased prevalence of overweight and obesity of young children in the diverse US affiliated Pacific región

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Background and objectives: The US affiliated Pacific region includes US states and territories that are not surveyed in US public health surveillance systems, yet there is evidence of nutrition transition in the region. The population is highly diverse with overall high overweight and obesity prevalence and poor diet quality among children, compared to the US contiguous states. The Children's Healthy Living program addressed this gap with nutrition assessments, and a multilevel multicomponent trial with community engagement, capacity building and outreach.

Methods: Twenty-seven communities in 5 Pacific jurisdictions (Hawaii, Alaska, Northern Mariana Islands, American Samoa, and Guam) were randomized. Children, 2-8 years (n=9840), were surveyed, including measured anthropometry and acanthosis nigricans visual inspection at 3 time points - baseline, 2 years (post-trial), and 6 years (maintenance period).

Results: Prevalence of child overweight and obesity decreased in intervention relative to control communities by 4% after the 2 year trial, and by 12.6% 6 years after the baseline measures, and by 8.7% in the 4 years after the trial ended.

Conclusions: A community-based, community-randomized, multilevel, multicomponent, capacity building program resulted in a long-term reduction in the prevalence of childhood overweight and obesity in the diverse US affiliated Pacific region.

Keywords: child, nutrition, Pacific, obesity, community

Further Collaborators: Many community partners

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)6-01

Capacity building for enhanced research on nutrition and cancer in low- and middle-income countries

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Background: The fast transition in dietary patterns and food production observed in low- and middle-income countries (LMICs), particularly among the poorest people and communities, is leading to more nutrition-related types of cancer. There is an urgent need to better understand the situation and to develop effective approaches to prevention and care requiring high quality research in nutrition and cancer research led by experts from/within LMICs.

Objective: We are working towards building a more extensive capability and stronger and sustained capacity for excellence in research and practice across LMICs. This fundamental and critical challenge is the concern of the International Collaboration on Nutrition in relation to Cancer (ICONIC), which is fostering capacity building as a core ambition. ICONIC is looking to identify the best way to develop and implement training and improve the preparation of grant proposals, especially for the most vulnerable places in LMICs.

Results: Several activities are currently ongoing: 1. Each year, an international course on study designs is provided for scientists who want to gain knowledge in cancer epidemiology and experience with writing grant proposals involving epidemiological studies on nutrition and cancer; A total of 12 scientists from 7 African countries have been initially trained within the scheme of this programme, and a third course is planned late 2022. 2. Together with the founders of the European Prospective Investigation into Nutrition and Cancer (EPIC), the necessary steps are identified to build a major collaborative international study: an international prospective cohort study in Africa ('APIC'). Currently, these activities are coordinated by ICONIC and conducted together with Wageningen University and CANA (Cancer and Nutrition in Africa), a group of African scientists formed within the African Nutrition Society (ANS).

Conclusion: A structured approach to the development of capability and capacity for high quality research related to nutrition and cancer is a high priority for LMICs to improve prevention and treatment. We look forward to sharing experiences and to engage with others interested in and committed to this vision.

Keywords: nutrition, cancer, capacity building, grant proposals, prospective studies

SY(T6)6-02

The role of nutrition and other lifestyle factors in paediatric oncology

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Background and objectives: Lifestyle factors such as nutrition and physical activity have been related to several chronic diseases, including certain cancer types. However, the role of nutrition and other lifestyle factors in the development of childhood cancers remains unclear. Certain dietary factors, like coffee drinking during pregnancy, have been associated with the risk of developing childhood cancer, while at the same time the nutritional status of children with cancer has been associated with therapy success and survival. We aim to provide an overview of ongoing research projects aiming to investigate the potential role of nutrition and other lifestyle factors in paediatric oncology.

Methods: We will provide an overview of the epidemiological evidence regarding the potential role of nutrition and other lifestyle factors in the development of childhood cancer and more in particular for Childhood Acute Leukemia, the most common type of cancer in children. Secondly, we will give a synopsis of ongoing projects in the Nutrition and Metabolism Branch (NME) at IARC that aim at investigating the role of nutrition and other lifestyle factors in paediatric oncology.

Results: Overall, a recent review of the literature indicates that a maternal diets rich in fruit and vegetables and supplementation with folic acid and other vitamins could potentially reduce the risk of Childhood Acute Leukemia, while coffee drinking during pregnancy may be positively associated with the risk Childhood Acute Leukemia. In addition, several projects have been launched to investigate the role of nutrition and lifestyle factors on cancer prognosis among children with cancer. An information resource is being set up by the International Initiative for Pediatrics and Nutrition (IIPAN) and NME, for advancing high-quality research in nutritional science and pediatric oncology. Data derived from dietary assessments and blood and stool samples taken for monitoring and assessing nutritional status are being used to investigate the metabolic effects of all forms of malnutrition and its impact on treatment efficacy and prognosis. **Conclusions:** This review of the epidemiological evidence together with clinical data and biological specimens will foster future studies on cancer progression and prognosis as well as toxicities during treatment that may impact survivorship and late-effects.

Keywords: Nutrition, Lifestyle, Childhood cancer, Paediatric oncology, Prognosis

Further Collaborators: Projects described are collaborative efforts between the Nutrition and Metabolism Branch at the International Agency for Research on Cancer (IARC), World Health Organization (WHO) and the International Initiative for Pediatrics and Nutrition (IIPAN), as well as the different IIPAN sites where IIPAN-affiliated trained personnel will facilitate the research objectives adhering to standard-operating-procedures set forth by IIPAN and IARC.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)6-03

Prehabilitation within the management and support of those living with cáncer

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The global burden of cancer disproportionately affects low- and middle-income countries (LMICs) with over 11.4 million incident cancer cases diagnosed in LMICs among the 19.3 million cases reported globally in 2020. Likewise, cancer mortality is markedly elevated in LMICs, with over 7 million deaths in 2020. Diagnosis with cancer in LMICs is often associated with malnutrition, anxiety, depression, and even financial toxicity. We know that people with cancer who are under-nourished, physically unfit, and psychologically distressed after diagnosis have poorer outcomes from their cancer and its treatment than those who are better nourished, fitter and more psychologically resilient. Prehabiltation, the process of identifying those individuals most at risk and intervening early through structured exercise, nutritional and psychological support prior to starting treatment, aims to better prepare patients for surgery and/or anti-cancer therapies and improve outcomes. Prehabilitation interventions developed in high income countries (HICs) settings have been shown to result in enhanced recovery, reduced length of stay and treatment complications, improved nutritional status and cardiorespiratory fitness, and overall better quality of life during and after treatment. In contrast to HICs, healthcare care systems in LMICs are less well integrated, often funded and managed vertically, and have multiple challenges in terms of human and financial resources. If the principles and guidance of prehabilitation developed in HICs were applied and translated into culturally-sensitive interventions in LMICs and shown to be feasible and similarly effective, these low-cost approaches may confer important opportunities to improve the response to treatment and the quality of life of cancer patients. The prehabilitation package of care needs to be owned by and with those able to comprehend the complexities and specificities of health systems in LMICs. The implementation of prehabilitation in LMICs will require the development of screening and assessment tools that are fit for purpose in LMICs as well as capability and capacity building using standardized protocols and information management through a trusted network of collaborating centers across countries. Success is dependent on building effective collaborations between HICs and LMICs and South-South collaborations to share experience and understanding which will involve patients, academics, civil societies, services providers, knowledge users and policymakers to determine the factors that will influence the adoption, implementation, impact, and sustainability of prehabilitation interventions within clinical services locally, nationally, and regionally. Work has already started in Africa with Cancer and Nutrition in Africa (CANA), a working group under the umbrella of the African Nutrition Society (ANS) and the International Collaboration on Nutrition in relation to Cancer (ICONIC). For the past two years, CANA has worked collaboratively with Wageningen University, ANS and ICONIC to develop a course on grant writing for cancer and nutrition research in Africa. CANA's agenda involves the development of a community of practice for Africa. This will ultimately lead to research projects on nutrition and cancer, especially on the role of nutrition as an important component of prehabilitation.

Keywords: prehabilitation, cancer, nutrition, collaboration, capacity building

Further Collaborators: Cancer and Nutrition in Africa (CANA) group

SY(T6)6-04

Supporting better collaboration in nutrition and cancer: A global approach.

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Background: Cancer prevalence is increasing worldwide, accounting for nearly 10 million deaths in 2020. Inappropriate diet, nutrition and physical activity as major preventable causes. Estimates indicate that cancer will be the most common cause of mortality and morbidity by 2050, increasing greatest in Low and Middle Income Countries (LMIC), where resources for prevention and care are relatively limited.

Objective: The International Collaboration on Nutrition in relation to Cancer (ICONIC), set up in 2018 as Task Force of IUNS, promotes and facilitates collaboration between the scientific communities in nutrition and cancer – for research, education and training, and in clinical and public health practice.

Methods: ICONIC has focused activity on three where the need was evident and possibility for traction appeared greatest: prehabilitation, childhood cancers and capacity building, focussing on LMICs where data are limited.

Results: Firstly, ICONIC recognises the role of prehabilitation (personalised management of exercise, nutrition and psychological support) in preparing patients for treatment, increasing resilience to treatment and improving longer-term health. Secondly, ICONIC is facilitating new and stronger connections amongst multiple stakeholders involved in nutrition and childhood cancer research, with the development of an agreed framework for better enabling collaboration, sharing understanding, identifying knowledge gaps, and setting research priorities for improved care. Thirdly, ICONIC in recognising the need for wider capability and stronger capacity for excellence in research and practice across LMICs, a structured training course has been established with a particular focus on the special needs for Africa in the first instance.

Conclusion: A focus on these three areas in the first instance, is helping to drive forward the ambition to bring change and make a meaningful difference. There is the need for large-scale prospective cohort studies in LMIC, similar in character to European Prospective Investigation into Cancer and Nutrition (EPIC). We are helping establish the base capability with which it will be possible, for example, to conduct studies across multiple sites in LMIC that will capture diversity of cancer sites, diversity

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DOI: 10.1159/000530786

of dietary patterns, nutritional status and physical activity, with appropriate biomarkers of nutritional status and cancer characteristics.

Keywords: Cancer, Nutrition, Physical activity, Rehabilitation, children and young adults

SY(T6)7-01

Food Loss and Waste: Why it matters to all

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The world produces enough food for all human beings to eat and enjoy a healthy and active life. Yet, over 800 million people on earth do not have access to enough food, in quantity or in quality. At the same time, it is estimated that one third of the food produced painstakingly ends up being thrown away. In addition to its significant economic and health impact, food loss and waste (FLW) is also a major cause of greenhouse gas emissions, the consequences of which can negatively affect anyone, anywhere. This presentation will feature the current situation of FLW, its causes and consequences, before highlighting some recommendations that everyone can implement to contribute to a more sustainable world.

Keywords: Food Loss and Waste (FLW), Food security, Nutrition, Sustainable Development Goals (SDGs), Sustainable behavior

SY(T6)7-02

The Myth of Food Loss: Why this is a problem to solving larger problems

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"If I had just one hours to save the world, I would spend 55 minutes defining the problem and five minutes coming up with solutions." Einstein In the case of food loss/food waste (FLFW) this has been turned on its head. Go to any conference or read material related to FLFW and the discussion is focused on either the morality of the issue or how to "solve" the problem. The moral question is framed as, "How can we waste so much food when so many people are hungry in the world?" Then unsubstantiated statistics will be presented to punctuate the question.

"Solutions" to FLFW range from peeling carrots more efficiently to using the last 15 minutes of a party to consume all remaining food (the Japanese government has promoted both of these). Also apps abound claiming they will match surplus food with eager consumers and thus reduce FLFW. And organizations have made it their mission to solve FLFW through awareness campaigns and community engagement. While it is evident people feel their actions make a difference, there is no evidence they have impact. I would suggest that food loss and food waste are natural by-products of our market-driven system. This system rests on the fundamental principal of choice. We freely choose that which we want to consume. The trade-off of choice is not everything is consumed. A world of zero food waste is a world with zero choice. This paper challenges the commonly accepted ideas of FLFW and points to three fundamental overlooked issues. First, the very definition of FLFW is not universal. Each country, and in some cases even within the government, have different working definitions which calls into question how success can be measured. Second, the innate nature of FLFW in the supply chain can be summed up in the equation P> M> C, where P=production, M=market, and C= consumption. We will always produce more than is consumed. Lastly, choice is fundamental from farm to fork. This choice will always create winners and losers (consumption and waste). This paper will address the moral outcry of food waste and when so many go hungry each night. While it is a natural human response to feel pangs of guilt to seeing food thrown away knowing others do not have enough, reducing FLFW will never eliminate hunger or food insecurity. Fundamentally these two issues have very different causes and solutions. Connecting these two issues is counterproductive. We need to decouple the connection between FLFW and hunger/food insecurity. It is time we take an adaptive leadership approach and engage a wider range of stakeholders to reconsider what problem we are trying to solve as well as solutions we can test. There are real consequences of putting resources into campaigns with no hope for meaningful impact. They lead us to believe we are making a difference, when in fact they distract us from what is actually important.

Keywords: Food loss, Hunger, Food waste

SY(T6)7-03

Japanese Policies for Enacting and Implementation of Act on Promotion of Food Loss and Waste Reduction

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Reducing food loss and waste (FLW) has become a global issue. In light of this, Japan has set a national target of halving FLW from its 2000 total by the year 2030. The Act on Promotion of Food Loss and Waste Reduction, which was enforced on 1 October, 2019, aims to promote the reduction of FLW as a

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

national movement through cooperation between a wide range of stakeholders. This presentation summarizes the current situation on FLW, an overview of the Act, and the Basic Policy on Promotion of FLW Reduction in Japan.

Keywords: food loss and waste (FLW), national movement, national target of halving FLW, national action, SDGs (Sustainable Development Goals)

SY(T6)-04

Global Environmental Issues: Food and Agriculture Education to Address Food Loss and Waste, Aiming at a Sustainable Supply Chain

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The 2030 Agenda for Sustainable Development adopted at the 2015 United Nations Summit, set a goal to halve global food waste at retail and consumption levels in the Sustainable Development Goals (SDGs). As part of this initiative, governments are required to reflect the SDGs in national planning processes, strategies, and policies with due consideration for the circumstances of each country. It is estimated that food waste of 25.31 million tons and food loss of 6 million tons occurred in Japan during FY 2018. Of this total amount, 3.24 million tons of waste was generated from business including the food manufacturing, wholesale, retail, and restaurant industry, and 2.76 million tons was generated from households. Consequently, it is crucial to mitigate both upstream and downstream food loss. In particular, the consumption patterns of consumers greatly influences not only downstream but also upstream food loss. Special emphasis must therefore be placed on increasing consumers' awareness regarding this global issue, and several programs have been initiated toward this end. Our research reveals that enhancing consumers' skills alongside awareness is of vital importance to efficiently reduce downstream food loss. Additionally, business operators must invest in improving skills of people-in-charge to minimize food loss in commercial set ups. Thus, educating both consumers and businesses with the requisite skills to lessen food loss is equally indispensable. The authors are developing impactful games to aid imparting of such education. Specifically, these include vegetable supply chain games where consumers are players and milk supply chain games where businesses as players. Vegetable supply chain games are games which simulate the vegetable supply chain, demonstrating what type of consumers actions will lead to food loss directly or indirectly and how these effects can be mitigated. In addition, milk supply chain games can simulate the 1/3 rule, a Japanese business practice. These games will examine how the business practice of the 1/3 rule affects the amount of loss at each stage of the supply chain (producer, dairy maker, supermarket, and consumer) and how to reduce the loss. The present talk will introduce some of the studies that have been undertaken by the authors to reduce food loss. During the course of this lecture, "food waste" refers to foods that are still edible and those which were originally inedible, such as meat and fish bones accumulated during food processing. Additionally, “food loss" refers to discarded foods that were originally edible, such as dented canned food or unconsumed food that was procured in large quantities at bargain price (untouched food).

Keywords: Food Loss and Waste, Sustainable Food Supply Chain, Food Supply Chain Game, 1/3 rule, Consumer Education

SY(T6)8-01

New actions to reduce anaemia and risk of overweight and obesity in infants and young children in low-income urban areas of Peru: The PERUSANO study

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Background and objectives Multiple forms of malnutrition coexist in infants and young children (IYC) in Peru. The PERUSANO project aimed to develop new culturally appropriate interventions and policies (actions) to simultaneously reduce risks for micronutrient deficiencies and overweight/obesity in IYC living in low-income urban areas of Peru. The specific objectives were to: i. identify factors influencing infant and young child feeding practices (IYCF) and forms of malnutrition; ii. map and prioritise actions currently in place at national level to target multiple forms of malnutrition; iii. develop and pilot new actions to address multiple forms of malnutrition among IYC through participatory methods and prototyping interventions with families, childcare and health facilities; and iv. work in partnership with local health services and stakeholders to develop capacity to implement participatory IYCF interventions.

Methods: This study included two main phases: i. a formative phase to understand the specific problem of malnutrition in Peru, its drivers and policy landscape, and ii. a design phase to pilot and evaluate new interventions. Here we describe the first phase and how it informed the design phase. The formative phase was divided into four work packages (WP). WP1 assessed the healthiness of IYC diets quantitatively and factors associated with malnutrition via a cross-sectional study of mother-infant dyads (n=244) from Manchay (Lima) and Huánuco district (Huánuco). WPs 2 and 3 aimed at gaining in-depth understanding of family/caregivers (WP2) and health centre/day care centre influences (WP3) on IYCF practices through observations (n=47) and interviews (n=194). WP4 assessed the current implementation of and priority for government actions to tackle multiple forms of malnutrition by conducting in-depth interviews with 16 national experts. To inform the design phase (start date

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DOI: 10.1159/000530786

January 2022), we engaged in several steps: i. *step 1*: collate a list of priority challenges from each WP; ii. *step 2*: group similar challenges together to create an affinity diagram; *step 3*: refine the affinity diagram by verifying this classification with WP leads (validation step); and *step 4*: run an online project scoping workshop to enable members to vote on their top four priority challenges from across all WPs (n=29). The top four challenges retained were discussed in small groups using the "how might we" technique to identify barriers/facilitators to their implementation.

Results: The top four challenges to take forward to the design phase included: i. high consumption of unhealthy foods and sugar-sweetened beverages in IYC; ii. Low use of (or difficulties with) iron supplementation in IYC; iii. Issues with nutritional counselling; and iv. Lack of monitoring in the health system to track progress around the double burden of malnutrition in IYC. **Conclusions:** The mixed methods formative work conducted by a team of interdisciplinary researchers was instrumental in identifying and prioritising opportunities to tackle multiple forms of malnutrition among low-income urban communities in Peru. This work also captured the views of stakeholders at different levels of influence (individual, community and institutional, and national level), which is crucial to obtaining a comprehensive appraisal of the problem and to inform the design and implementation of interventions.

Keywords: drivers, actions, infants and young children, malnutrition, Peru

Conflict of Interest Disclosure: None

Further Collaborators: Oonagh Markey, Emma Haycraft, Edwige Landais, Doris Delgado, Maria Inês Varela Silva, Luzvelia Alvarez Ortega, Silna Teresita Vela Lopez

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SY(T6)8-02

Participatory design to develop prototypes for interventions aimed at tackling malnutrition in all its forms in Peru: The PERUSANO study

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Background and objectives: The prevalence of undernutrition and overweight/obesity is high in Peru, particularly impacting children of low socioeconomic status. Caregivers play an important role in infant and young child feeding (IYCF) practices. However, their needs, barriers and their voices are not usually considered in the design of interventions aiming to enhance IYCF practices. In this work, we examine the iterative process of designing socio-technical interventions to improve IYCF using participatory methods, that go beyond traditional methods such as interviews and observations. Instead, we brough together interdisciplinary researchers, healthcare professionals, and caregivers to develop more culturally adequate strategies.

Methods: Taking a human-centric approach, we examined the role of different participatory qualitative methods and tools to support the understanding of the context, the user's needs and motivations, and to elicit iterative feedback. We created and validated a set of tools including a storyboard, design cards and a design workbook to support the reflection on IYCF challenges and the early stages of design for and with Peruvian communities (healthcare professionals and families) in Lima and Huánuco. These tools are essential materials to support co-design activities of IYCF interventions.

Results: Based on the iterative design process and early validation of design materials, we will outline the challenges and opportunities to support the early reflection of community IYCF priorities and the material's potential for brainstorming, early ideation, and prototyping of culturally and contextually relevant strategies and interventions to enhance IYCF practices. We found that early identification of sociocultural characteristics of the communities is fundamental to accurately represent the communities' experiences. Additional lessons learned include considering and balancing interdisciplinary perspectives within and beyond the community and facilitating a shared understanding for both the healthcare professionals and the local families.

Conclusions: The use of participatory research methods in Peru has been challenging especially during the pandemic where alternatives to face-to-face participation had to be developed. Participatory research methods are quite new, especially in the healthcare context, where traditional methods often do not involve the community in the design process of health interventions. Our methods have helped us to understand the sociocultural context and the community health priorities giving the opportunity to the local participants to have a voice and engage in the co-design of the most suitable approach. Thus, design materials have the potential to address power imbalances by mediating the interaction among multiple stakeholders with different perspectives.

Keywords: Participatory methods, Peru, Community, Infant and young child feeding, Double-burden of malnutrition

Further Collaborators: Michelle Holdsworth, French National Research Institute for Sustainable Development-IRD, France; Emma Haycraft, Loughborough University, UK

SY(T6)8-03

Community readiness to improve food safety practices among informal food handlers: A qualitative analysis in the three major cities in Ecuador

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Background and objective: Food safety is a critical issue in low- and middle-income countries and is a barrier to healthy eating in Ecuador. This study aimed to explore community readiness to implement strategies to improve food safety among informal food handlers in urban Ecuador.

Methods: Using the **Community Readiness Model** (CRM), 40 in-depth interviews were conducted with key informants in the urban area of the three major cities in Ecuador (Quito, Guayaquil and Cuenca). Data collection was conducted from September to December 2020. The informants included governmental officials involved in regulatory actions regarding food safety among informal food handlers and non-governmental community members related to the preparation, transportation, and consumption of informally produced foods. The governmental informants belonged to the Ministry of Health, Food Safety Regulatory Agencies and the City council; the non-governmental informants comprised informal food handlers, consumers' advocacy groups, health professionals, food deliverers, and cleric representatives. The CRM determines the communities' willingness to implement preventive strategies for a specific problem (i.e., unsafe foods sold by informal food handlers) by exploring five critical dimensions (community knowledge of efforts, leadership, community climate, knowledge of the issue and resources). A score was assigned for each dimension (from 1 = no awareness to 9 = high level of community ownership), which was then used to generate an overall readiness score for each city. A thematic analysis was undertaken to understand the scores and identify critical factors (i.e., barriers or facilitators) for preventive strategies.

Results: The three cities were in a "denial/resistance" stage (Cuenca: 2.9 ± 0.4; Quito 2.9 ± 0.4; Guayaquil 2.8 ± 0.5), regarding the need to implement strategies to improve food safety among informal food handlers. In Cuenca and Quito, the scores ranged from denial to vague awareness for all the dimensions, with community knowledge about the efforts receiving the lowest score (Cuenca: 2.4 ± 0.8; Quito: 2.3 ± 1.4). In Guayaquil, the community knowledge about the efforts was in a "no awareness" stage (1.8 ± 0.8), while the other dimensions ranged from denial to vague awareness. Straightforward strategies to promote food safety among informal food handlers were not identified. Training sessions were mentioned as the primary strategy but seemed to be improvised. The governmental entities share roles in monitoring the food safety of informal handlers, resulting in unclear responsibilities and overlappings. Potential conflicts of interest of decision-makers were identified, and the community has several misconceptions and knows little about the problem and its consequences.

Conclusions: Food safety is not recognized as a priority in these three cities in Ecuador, even though it can have critical implications for healthy eating and overall health. Strategies aiming to improve community awareness of the consequences of consuming unsafe foods are urgently needed to pave the way for implementing appropriate preventive strategies to promote healthy diets in urban Ecuador. The generated data enables a clear understanding of existing strategies, stakeholder roles, and community perceptions, which can be the basis to co-design appropriate strategies.

Keywords: Community readiness, Food safety, Ecuador, Interventions, Urban

Conflict of Interest Disclosure: The authors declare no conflicts of interest

Further Collaborators: Daniela Peñafiel, Jenny Ruales, Juan Manuel Cevallos

SY(T6)8-04

How ready are community stakeholders to implement interventions to address the marketing and availability of unhealthy foods and beverages in and around schools in the Greater Accra Region of Ghana?

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Background and objectives: Ghana has reached an advanced stage of nutrition transition, contributing to increasing overweight and obesity, including in children and adolescents. There is widespread marketing and availability of unhealthy foods and beverages that have, in part, led to changes in dietary habits towards processed foods high in saturated fats, sugar, and salt. Emerging evidence shows a need to improve school food environments such that they promote the consumption of safer and more nutritious diets. The readiness of communities to accept a range of interventions to tackle this issue needs to be understood before appropriate interventions can be implemented. Therefore, this study assessed how ready the 'community' is to implement actions to address the marketing and availability of unhealthy foods and beverages in and around schools in the Greater Accra Region of Ghana.

Methods: The Community Readiness Model (CRM) protocol was used to conduct in-depth interviews with 18 key informants from various school/education/citizen sectors in Greater Accra, Ghana, which together represent the 'school community'. The CRM tool consists of 36 open questions addressing five readiness dimensions (community knowledge of efforts, leadership, community climate, knowledge of the issue and resources). Interviews were scored using the CRM protocol with a maximum

of 9 points per dimension (from 1= no awareness to 9=high level of community ownership). Thematic analysis was undertaken to gain insights into community factors that could influence the design and implementation of interventions to reduce the marketing and availability of unhealthy foods and beverages to improve diets among children and adolescents.

Results: The mean readiness scores indicated that the 'school community' was at the "pre-planning" stage (4.44 ± 0.98) to address the marketing and availability of unhealthy foods and beverages in and around schools. CRM scores across the five dimensions ranged from 3.19 (vague awareness) to 5.36 (preparation) on the 9-point scale. The mean readiness score for 'leadership' was the highest of all dimensions (5.36 ± 1.60), corresponding to the "preparation" stage. The lowest scores were found for 'community knowledge of efforts' (3.19 ± 2.45) and 'resources' (3.64 ± 0.87), both of which correspond to a "vague awareness" stage. This relatively low readiness level could be explained by challenges with limited resources, such as poor funding for programmes. Additionally, while some efforts are ongoing to address unhealthy food marketing and availability, only a few community members had heard about them or knew about the scope of local efforts.

Conclusions: There is awareness among community members about the occurrence of marketing and availability of unhealthy food and beverages in and around schools and a high level of active leadership for improving food environments for children and adolescents. However, for any intervention to have maximum impact, initial actions must focus on increasing the community's knowledge of existing efforts and securing resources (e.g. funding) to initiate and sustain efforts.

Keywords: community readiness, unhealthy food, schools, marketing, Ghana

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SY(T6)8-05

Using participatory photography to identify drivers of dietary behaviours in adolescents and women living in urban Ghana

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Background and objectives: Evidence on the individual-level drivers of dietary behaviour in deprived urban contexts in Africa is limited. Understanding how to best develop and deliver interventions to promote healthy dietary behaviour is needed, especially in Ghana, where there is evidence of rising diet-related non-communicable diseases (DR-NCDs) amidst persistent food insecurity and micronutrient deficiencies. The study aimed to identify individual-level factors (biological, demographic, cognitive, practices) influencing dietary behaviours amongst adolescent girls and women at different stages of the reproductive life course in urban Ghana, with the goal of building evidence to improve targeted interventions.

Methods: Participatory photography can be used as a tool to increase understanding of communities' and citizens' everyday life, helping to facilitate communication between communities, researchers and decision makers. Qualitative participatory photography (Photovoice) interviews (n=64) were conducted in two low-income urban neighbourhoods in Accra and Ho with adolescent girls (13-14y) and women of reproductive age (15-49y). An exhibition was also held to display participant's photographs and foster discussion within these neighbourhoods, so that participants' voices could be heard. Interviews were transcribed verbatim and coded in NVivo (version 11) using both theoretical a priori themes and a data-driven coding scheme to allow for emerging themes. The African Food Environment framework was used to structure the synthesis.

Results: Thirty-seven factors, across four domains within the individual-level were identified as having an influence on dietary behaviours: biological (n=5), demographic (n=8), cognitions (n=13), and practices (n=11). Several factors emerged as facilitators or barriers to healthy eating, with income/wealth (demographic); nutrition knowledge/preferences/risk perception (cognition); and cooking skills/eating at home/time constraints (practices) among the most frequent. Pregnancy/lactating status (biological) was also observed to influence dietary behaviours mainly through medical advice, awareness and willingness to eat foods to support foetal/infant growth and development. The ability to eat nutritious, safe food was largely mediated by income and wealth. Time constraints, eating at home/out, cooking skills, food preferences and food safety concerns were identified as key factors influencing dietary behaviours at the individual level.

Conclusions: Many individual-level factors influencing dietary behaviour were perceived as important and are intertwined with the wider food environment. Using photovoice as a method helped shed light on these multiple factors in people's lived food environments. All these individual and environmental factors need to be taken into account when designing interventions and policies within Ghana.

Keywords: dietary behaviour, adolescents, Photovoice, women of reproductive age, Ghana

Further Collaborators: Robert Akparibo, University of Sheffield, United Kingdom; Nicolas Bricas, UNESCO Chair of World Food Systems, CIRAD, France; Senam Klomegah, University of Health and Allied Sciences, Ghana

SY(T6)8-06

Policy mapping of double-duty actions that address multiple forms of malnutrition in Peru

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Background and objectives: Multiple forms of malnutrition co-exist in infants and young children (IYC) in Peru. Double-duty actions (DDAs) have been proposed to simultaneously tackle undernutrition and overweight/obesity. We assessed current implementation of- and priority for- government-level actions to tackle multiple forms of malnutrition in IYC in Peru.

Methods: Mapping of current policy activity was undertaken against 47 indicators of good practice for 5 DDAs (exclusive breastfeeding, complementary feeding, food marketing, maternal nutrition, preschool nutrition; assessed by 27 indicators) and for the enabling policy environment, i.e. 'infrastructure support' (health in all policies, platforms for interactions, financing, monitoring, governance, leadership; assessed by 20 indicators). In-depth mixed methods interviews with 16 national experts explored their views on the level of and barriers to implementing DDAs and infrastructure support. Experts also prioritised the DDAs and infrastructure support indicators for their likely impact and feasibility. The mean rating for each good practice indicator was used to determine an overall percentage level of implementation (quantitative) and verbatim transcripts from interviews were analysed using NVIVO (qualitative).

Results: Only 5/27 of DDA indicators were seen as fully implemented by all national experts (international code of breastmilk substitutes marketing, iron supplementation, micronutrient powders in infants, iron/folic acid supplementation in pregnant women, paid maternity leave). More than half (14/27) of DDA indicators were rated as fully implemented by > three-quarters of experts. Only one infrastructure support indicator (access to nutrition information) was rated as fully implemented by all experts, and a further 8 indicators by more than half of experts. Barriers to implementation of the poorly implemented indicators for DDAs (13/27) and infrastructure support (11/20) included: legal feasibility or lack of regulations, inadequate monitoring/evaluation to ensure enforcement, commercial influences on policymakers, insufficient resources, shifting public health priorities with the Covid-19 pandemic and political instability. Going forward, experts prioritised 11 indicators across all 5 DDAs: breastfeeding (5 indicators), maternal nutrition (3 indicators) and 1 indicator each for complementary feeding, food marketing and preschool nutrition. Eight indicators for improving infrastructure support were prioritised for: strengthening leadership (3 indicators), monitoring and evaluation (3 indicators), and prevent multiple forms of malnutrition by increasing funding for interventions (1 indicator) and implementing policies (1 indicator).

Conclusions: Experts observed the need to improve implementation of all DDAs to address multiple forms of malnutrition and identified a range of ways that the enabling policy environment could be strengthened.

Keywords: double-duty action, infants and young children, malnutrition, Peru, policy

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: None

SY(T6)8-07

Addressing multiple forms of malnutrition through double-duty actions: Evidence-to-policy action from Ghana

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Introduction: Non-communicable diseases are predicted to become the leading cause of death in Ghana by 2030, amidst prevailing challenges of infectious diseases, undernutrition, and micronutrient deficiencies. Unhealthy food environments hinder progress to overcoming malnutrition in all its forms. Policies that aim to inform and empower; guide and influence; incentivize consumption of healthier diets, while disincentivizing less healthy ones are urgently needed.

Objective: We aimed to address the multiple forms of malnutrition in Ghana through context-appropriate and evidence-informed policy measures.

Methods: We engaged people in their communities, assessed communities/neighborhoods, and engaged relevant national-level food environment stakeholders to identify priorities for national action. We assessed how food and beverages are advertised, sold, and consumed in urban Ghana; assessed the healthiness of foods and beverages across food retail outlets and media channels; identified social and physical environmental drivers shaping dietary behaviors; identified priorities for policy and interventions to improve the food environment in Ghana, and determined how ready Ghanaian stakeholders are to reduce unhealthy diets and beverages consumption.

Results: The engagements, assessments, and evidence show that to improve the Ghanaian food environments, fit-for-local purpose double-duty policies, as well as strong leadership and accountability, are required to combat malnutrition in all its forms. Such policies include those that limit the availability of unhealthy diets in public institutions and markets, adjust the relative price of foods to equitably promote health and economic value, and ensure that food products have bold and truthful information for all consumers. The Ghanaian stakeholders pay heed. A coalition of government agencies, academia, and civil society are currently delivering multi-stakeholder action toward

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

a double-duty policy bundle for healthier and more equitable consumer food environments.

Conclusion: Evidence-informed advocacy and scholar activism have valorized demand for the policy bundle; the Ghanaian government is leading politically, and there is a national consensus that enactment and implementation of the policies will make unhealthy diets unattractive and unavailable while making healthier diets available, and attractive.

Keywords: Food environments, Double-duty action, Policy action, Evidence-to-policy, Ghana

Conflict of Interest Disclosure: The authors declare no competing interests

Further Collaborators: The background data and evidence undergirding the current efforts described in the abstract derive from previous projects such as the DFC-Dietary Transitions in Ghanaian Cities Project, and the MEALS4NCDs Project. The exhaustive list of collaborators is not included in the submission

SY(T6)9-01

Framework for development of the Dietary Reference Intakes

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The Dietary Reference Intakes (DRIs), supported by the United States (US) and Canadian governments, were initiated in 1994 by the Institute of Medicine (IOM) in Washington DC in response to expanding needs for nutrient reference standards beyond the single-value Recommended Dietary Allowance (RDA). As a result, the DRIs include the Estimated Average Requirement (EAR; an estimate of the median or average requirement for the specified indicator of adequacy for an age/sex/life-stage group), the RDA (an intake that that meets or exceeds the requirements of almost all (97-98%) members of an age/sex/life-stage group), the Tolerable Upper Intake Level (UL; an intake level above which the potential risk of adverse effects may increase), and an Adequate Intake (AI; an intake level thought to meet or exceed the needs of almost everyone in an age/sex/life-stage group that is used when an EAR/RDA cannot be established). The process of developing the DRIs, which has come to be known as the DRI Framework, is intended to ensure transparency of the decision-making process and also to recognize the need to make decisions based on limited data. A 4-step risk-assessment approach is used, beginning with the identification and review of potential indicators of both adequate and excessive nutrient intake for age/sex/life-stage groups, followed by selection of the most appropriate indicators based on strength and quality of the evidence. The second step includes determining the intake-response relationships between the nutrient and the selected indicator(s) and specifying the DRIs. This includes consideration of uncertainty factors, variance in requirements, nutrient interactions, bioavailability and the need to scale or extrapolate when data are limited. In the third step, data on intake of the nutrient (and as available, on biochemical and clinical measures of nutrient status) are compiled and assessed in preparation for the final step of risk characterization. This final step includes a discussion of the public health implications of the DRIs (e.g., whether particular age/sex/life-stage groups are at risk of inadequacy or excess) as well as whether the reference values may need to be modified for particular subgroups within the population. In 2017, the DRIs were expanded to include the Chronic Disease Risk Reduction Intake (CDRR), which is an intake range for a nutrient that can be set when there is at least moderate strength of evidence for both a causal and an intake-response relationship between intake of the nutrient and risk of a chronic disease. It is likely that the DRI process will continue to evolve in the future.

Keywords: Dietary Reference Intakes, dietary requirements, dietary assessment

SY(T6)9-02

Dietary Reference Intakes for Japanese (2020)

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"Dietary Reference Intakes for Japanese (2020)", DRIs-J (2020), was issued from Ministry of Health, Labour and Welfare, in 2019 and will be officially used until March of 2025. In 2005, Japan abolished Recommended Dietary Allowances and issued DRIs. Since then, the revised edition has been issued every 5 years. DRIs-J (2020) describes recommended intake values by sex and age-class and the explanations for energy and 34 nutrients (note: dietary cholesterol only has explanation, but shows no value). Estimated energy requirement (EER) is used for intake values of energy. For those of nutrients, either estimated average requirement (EAR), recommended dietary allowances (RDA), adequate intake (AI), upper tolerable intake value (UL), tentative dietary goal for preventing lifestyle-related diseases (DG), or some of them are used. DG has uniquely been developed and been introduced to the DRIs-J (2005) by considering a serious need for prevention of lifestyle-related disease in Japan. At the same period, DRIs-J (2005) has introduced the chapter "basic concepts" that described basic knowledge on developments of and how to use DRIs. The chapter "basic concepts" has still an important role in DRIs-J (2020). DRIs-J (2015) has introduced "preferred body size for adults" as energy control in addition to EER. It stated that optimal body size expressed as body mass index was between 21.5 or 22.5 (which depends on age-class) and 25.0 kg/m2. DRIs-J (2015) has also introduced a new chapter called "relation between chronic diseases and nutrients". This chapter summarized the relationship between four major chronic diseases such as high blood pressure, dyslipidemia, type-2 diabetes, and chronic kidney disease and intakes of selected nutrients. In DRIs-J (2020), relation between frailty and selected nutrients has been added considering a social need, but the description was short and no concrete intake values were

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DOI: 10.1159/000530786

suggested because of scarcity of the scientific findings. DRIs-J has consistently kept the importance of avoidance of insufficiency and of excess of tolerable intake level for nutrients and the importance of adequate energy intake, and at the same time has gradually increased information on chronic disease prevention and control. We would like to keep this high scientific level and change it more easy to use for users such as dietitians.

Keywords: Dietary Reference Intakes, Public Health Nutrition

SY(T6)9-03

Vietnam Recommended Dietary Allowances: current and challenges

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With the increase in the country's economic growth, food supply has improved. Vietnamese diet has significantly changed. National Survey on Food Consumption 2020 showed that the average daily energy intake was 2023kcal per day, slightly increased in comparison with that in the year 2010 (1925kcal). The proportion of energy from protein, fat and carbohydrate is 15.8%, 20.2% and 64%. The quantity of vegetable intake is 231gr/day and that of fruit is 140.7gr/day, meat intake is 136.4gr/day, that in rural area is 155.3gr/day, the consumption of fast-food and sweetened drink is increased. Stunting is prevalent among children under 5 and micronutrient deficiencies is still common but overweight/obesity, metabolic syndrome and other chronic diseases related to nutrition and lifestyles is raising. The most updated Recommended Dietary Allowances (RDA) for Vietnamese population was developed in 2016. It is therefore necessary to revised the RDA for the Vietnamese population with the change of the current morbidity and mortality, and the current eating habits and food consumption. The revised RDA would be an important science-based tool for the development of healthy Vietnamese dietary guidelines and the evaluation of food and nutrition security in Vietnam. It is expected that the revised Vietnam RDA and its conversion to food-based dietary guidelines will be the basis for the policy implementation of programs for prevention the double burden of both under and over nutrition as micronutrient deficiencies, stunting and noncommunicable chronic diseases.

Keywords: Recommended Dietary Allowances, Nutritional requirement, Energy, Protein, Micronutrients

SY(T6)9-04

Current issues of DRIs and RDAs in German-speaking countries

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The DRIs in the German-speaking countries date back to the year 1956 when the German Nutrition Society published its dietary reference values for energy, protein, fat, calcium, iron, iodine, and the vitamins A, D, B_1, B_2 , and C. Regular revisions followed over the next decades, taking into account new evidence on nutrient requirements and the changing lifestyle of the population. Since 2000, the D-A-CH reference values are published and regularly updated as joint intake recommendations for Germany (D), Austria (A) and Switzerland (CH) and were also adopted by Hungary, the Czech Republic, Slovenia, and Serbia. At the regional level, the D-A-CH reference values have also served as a basis for the development of some RDIs of the European Food Safety Authority (EFSA) but some discrepancy exists. A hallmark of the D-A-CH DRIs, which was introduced in 1995, is the differentiation between recommended intake levels, estimated intake levels and values given as orientation depending on the scientific evidence available for a given nutrient. Some uncertainty as to the appropriate levels for some nutrients still remains as shown for folate, for which analyses in the frame of the Austrian Study on Nutritional Status 2012 revealed a notable discrepancy between dietary intake and the biochemical status of this nutrient that led to the lowering of the DRI from 400 μg/d to 300 μg/d in the following revision of the D-A-CH reference values. Recent adaptations include the introduction of varying recommended intakes for zinc depending on the diet's estimated phytate content, an approach that was proposed by the WHO and is also found in the EFSA DRIs, and the adoption of a conversion factor of 12:1 for beta-carotene to vitamin A. New evidence underlines the importance of preventive aspects of nutrient intake. This has, for instance, entailed higher recommendations for protein intake in elderly persons aged ≧65 years and a DRI for potassium above basal requirements to account for the antihypertensive effect of this mineral. For future revisions of the D-A-CH reference values, more studies on the nutritional requirements of infants and young children are particularly needed, for whom most DRIs are estimations.

Keywords: DRIs, Germany, Austria, Switzerland, RDA
Conflict of Interest Disclosure: no conflict of interest

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)10-01

Revisiting the potential of growth monitoring and promotion

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Background and objectives: Growth monitoring means following the growth of children by periodic, frequent anthropometric measurements that are used to assess the adequacy of the child's growth. Growth monitoring and promotion programs include healthy growth promotion activities, mostly as tailored, individual counseling based on the child's growth results. Some programs also include group counselling and are used as a platform to bring communities together to discuss child growth and nutrition topics. Three broad categories of purposes, which may overlap, are screening, providing a source of data, and providing a platform to deliver or promote other health and nutrition services. Although growth monitoring and promotion programs have been widely implemented for many decades, their appropriateness and effectiveness are uncertain and questionable. The objective of this introduction is to provide an overview of what is known about the appropriateness and effectiveness of growth monitoring and promotion, what are the issues that have been raised, and how to frame intellectual and empirical analyses to resolve these issues to indicate a path forward.

Methods: The literature on growth monitoring and promotion programs was reviewed. Evidence of effectiveness was compiled, and relevant concerns and questions were identified. **Results:** Five main issues concerning growth monitoring and promotion programs were identified. First, the epidemiological underpinnings of growth monitoring and promotion programs are not clear. Second, the data from growth monitoring and promotion programs may not be representative (i.e., subject to selection bias) and may not be reported in an adequate time frame, if reported at all. Third, the programs have poor implementation and coverage. Fourth, most countries implement growth monitoring and promotion programs despite the lack of evidence on effectiveness. Fifth, rigorous evidence on the usefulness of growth monitoring and promotion as a platform for delivering other services is missing.

Conclusions: Critical examination of the bases and potential of growth monitoring and promotion is needed to help redirect how these programs may be used to improve the nutrition and health of children and families.

Keywords: Growth, Development, Children, Growth monitoring, Growth promotion

SY(T6)10-02

Growth Monitoring and Promotion: A Global Perspective

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Introduction: Regular assessment of growth and development is critical during infancy and early childhood and is standard practice in an estimated 178 countries. Over the last four decades, countries have implemented various types of growth monitoring and promotion (GMP) programs, based in communities and/or health facilities, and offering a range of services and growth measurements. Despite lack of detailed information on global costs and mixed evidence of effectiveness, the widespread implementation of GMP raises important questions on costs, benefits, and value for money given the slow progress in key anthropometric indicators for children over time. Nevertheless, GMP provides unique access to vulnerable communities, promoting frequent contact with health workers and serving as a potential entry point for the delivery of other timely child health and development interventions, and especially so when delivered at scale.

Methods: A global convening that included eleven countries and over 60 thought leaders was co-hosted by The Global Financing Facility, The World Bank, The Bill & Melinda Gates Foundation, UNICEF, and The Manoff Group in 2018 to review the empirical and experiential evidence on GMP, and elaborate on implementation and data gaps hampering effective GMP implementation. Four years later, we conducted a desk review to revisit the status of GMP globally, and incorporate perspectives of The Global Financing Facility vis a vis implementation and progress in supporting countries to strengthen GMP programming.

Results: Costs of implementation are highly variable, dependent on level of coverage and diversity of activities. Program data from 5 countries who participated in the 2018 global convening shared annual program costs that ranged from 2 to 200 million in Madagascar and Ethiopia, respectively. The intersection between scale of implementation and questionable impact signals the need for a paradigm shift in GMP programming, especially in the context of renewed global attention to and financing of nutrition scale-up driven and supported by global initiatives. The paradigm shift includes: (1) a clear definition of which types of measurements to focus on, if any, and potential variations in program typologies based on country epidemiology and implementation arrangements and capacity; (2) the inclusion of overweight measurement and counseling; (3) the development and deployment of new tools, training, and skills development to improve the quality of GMP, particularly the use of data for decision-making at all levels; and (4) strengthening of links with referral services and incentives. Large donor institutions and financing mechanisms that support the strengthening of country systems to improve nutrition delivery at scale will continue to finance GMP in alignment with national priorities and plans, and government requests to do so.

Conclusion: There remain several fundamental, unanswered questions on operational aspects of GMP implementation. Clarity and attention to these is needed for institutions to more

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

effectively support the large-scale implementation of the needed paradigm shift in GMP, and to maximize the impact of GMP as a platform to promote child development and nutrition outcomes.

Keywords: growth monitoring and promotion, nutrition program implementation, anthropometric measurement

Conflict of Interest Disclosure: The author confirms there are no conflicts of interest to disclose.

Further Collaborators: The United States Agency for International Development (USAID), The Global Financing Facility, The World Bank, The Bill & Melinda Gates Foundation, The Manoff Group

SY(T6)10-03

The epidemiological underpinnings of growth monitoring and promotion

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Background and objectives: Growth monitoring is the process of following the growth of children by periodic, frequent anthropometric measurements that are compared to an appropriate standard to assess the adequacy of the child's growth. Growth monitoring and promotion (GMP) programs also include promotion activities, mostly in the form of individual counseling based on the growth results. The primary objective of GMP is screening and promotion, i.e., the early detection of inadequate child growth followed by counseling using a growth chart as an educational and promotional tool. GMP is also used as a source of data for decision-making and as a platform to promote the use of other nutrition and health services. Even though growth monitoring and GMP programs have been widely implemented for many decades, there is little evidence from rigorous research on their effectiveness. The widespread implementation of GMP around the world is largely motivated by the assumption that visualizing growth faltering using a growth chart will help parents recognize the problem and will make them more responsive to advice aimed at improving their child's growth, nutrition, and health. Praise for healthy growth is also expected to motivate parents to continue their positive practices. Examples of children growing well can be used as a model for other parents from the same community. Research on GMP, however, has almost exclusively focused on program implementation. Very few studies have looked at the effect of GMP on parents' nutrition knowledge and practices or on child growth. Most importantly, the epidemiological foundation of GMP has not been carefully studied.

Methods: We critically assessed the epidemiological underpinnings of the first GMP purpose (screening and promotion) and reviewed the evidence for the remaining two purposes (as a source of data for decision-making and as a delivery platform for other nutrition and health services).

Results: The rationale for screening (first purpose) is that the early detection of a health problem followed by an effective intervention increases the chance of a positive health outcome. Many of the requirements of a screening program, however, do not seem to be met in GMP programs. It is unclear whether growth faltering is a useful early marker of undernourishment or rather an advanced consequence of the health (or undernutrition) problem that is being screened for. Second, there are no generally accepted quantitative cut-offs to identify growth faltering at the individual level. And finally, there is no currently available treatment that can bring the child back to the "healthy" linear growth trajectory. Relative to the second purpose, a key challenge is the lack of representativeness since children taken to the GMP session are not necessarily representative of the whole population or community. Rigorous evidence on the effectiveness of GMP as a platform to promote the use of health and nutrition services (the third purpose) is missing.

Conclusion: We conclude that the epidemiological foundations of GMP may not provide the necessary justification to continue with GMP in its current form. It is thus necessary to critically revisit the potential of GMP to improve the nutrition, health, and development of individual children.

Keywords: growth monitoring and promotion, child, nutrition, health

SY(T6)10-04

Rethinking growth monitoring and promotion as an opportunity to improve early childhood development

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Background and objectives: Growth Monitoring and Promotion (GMP) is broadly regarded as an essential component of primary health care. It is widely used to screen children for nutritional or health problems, but there is limited evidence on the effectiveness of GMP on nutritional status of children. One strength of GMP visits is the frequent contact between caregivers and health workers. This point of contact may provide an opportunity to screen for children at risk of developmental delay and, if necessary, intervene with the aim of improving child development. Our study's first objective is to examine the potential of GMP's established platform to identify children at risk of poor development. Second, we will evaluate whether GMP can be used to deliver responsive parenting education to caregivers of young children in need.

Methods: We will conduct a literature review to determine the sensitivity and specificity of anthropometric indices in identifying children at risk of developmental delay. We will review the evidence of the validity of child development measurement tools that are easy to implement, free of cost, and which could be used to screen children for developmental risk during GMP visits by trained unskilled health workers. We will

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

assess the sensitivity and specificity of anthropometric indices using existing data, including data from the Multiple Indicator Cluster Surveys and other studies that used standard measurement tools for child development, such as the Bayley Scales of Infant and Toddler Development. We will identify light-touch versions of existing early childhood development programs which could feasibly be delivered by health workers during GMP visits.

Results: Drawing on both studies in the literature and our own analyses of available data, we will document the accuracy of anthropometric indices in identifying children at risk of developmental delay. Through a review of peer-reviewed and grey literature and through discussions with key experts in the early childhood development field, we will identify the characteristics of early childhood development programs that make them feasible and effective for implementation during GMP visits (i.e., group vs individual sessions, home vs clinic-based sessions, number of visits, adaptation requirements, etc.).

Conclusions: We will conclude with an appraisal of the potential of GMP to serve effectively as a platform to identify children at risk of poor development and deliver responsive parenting education to caregivers of young children in need.

Keywords: growth monitoring, child development, global nutrition

SY(T6)10-05

Implementation of growth monitoring and promotion: Lessons from India

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Background and objectives: Growth monitoring (GM) and promotion is a routine part of primary healthcare for children in > 80% of countries. In India, 57.5 million children are measured every month by frontline workers to assess their growth and to trigger preventive or curative services. Standard guidance for anthropometry suggests quality can be compromised by the choice of measurement equipment, placement of equipment, and positioning of children during measurement. Little is known about the quality of measurement processes during GM.

Methods: We compared child height and weight measurement processes with standards for anthropometry to assess GM quality. We observed the process of measuring weight and height of children under 5 years of age (N=681) in 4 states in India, using a checklist. We summarized data along critical measurement falter points that could affect quality. Open-ended interviews were conducted with caregivers to assess how they value GM.

Results: Nearly 75% children were weighed using age-appropriate weighing scales. However, the scales were not used appropriately in all cases. However, for Salter scales, only 44% of children were placed in sling/pants as appropriate for their age. Nearly 30% of children wore heavy clothing and 45% of children were not calm during weighing; > 60% were weighed in a sitting/standing position on a baby-weighing scale. More than 50% of infants were not measured using age-appropriate height equipment. Height equipment was placed on a stable surface while measuring majority of children, but a large proportion of children were incorrectly positioned on the equipment. Caregivers valued GM and reported having children routinely weighed to learn about any changes; nearly half the caregivers considered weight as a marker for child growth.

Conclusion: Multiple measurement-related falter points were observed during GM. Incorrect measurements increase the potential for under-or over estimation of weight/height and consequent misclassification for screening and referrals. GM results are used to refer children diagnosed with malnutrition to additional health and nutrition services. Routine GM appears to be an assurance of child growth to caregivers. Therefore, it is imperative to strengthen the quality of measurements, focusing on the falter points, to ensure better data for programmatic and for caregiver use.

Keywords: Growth Monitoring and Promotion
Conflict of Interest Disclosure: None
Further Collaborators: Not applicable

SY(T6)11-01

Introduction to the Whole Grain Initiative: Goals and Vision for Healthier Dietary Lifestyles

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Dietary lifestyles that include higher intakes of whole grain have been correlated with reduced risk of disease, healthcare cost savings, and potentially even lower environmental impacts. Although whole grains are recognized in dietary guidance recommendations around the globe, these recommendations can be vague and consumption remains low. The Whole Grain Initiative (www.wholegraininitiative.org), which arose from the 6th International Whole Grain Summit (Vienna, 2017), seeks to improve consumer and planetary health through a transition from the consumption of mainly refined grains to whole grain. To accomplish this goal, expert working groups were formed each tasked with pursuing unique, independent strategies that contribute toward the case for whole grain. Working groups include whole grain definitions group, economics group, communications group, sustainability group, and a policy group. Ultimately, products from each working group will contribute to a comprehensive dossier on whole grain to spur government and non-government organizations to invest in policies and programs that encourage the public to swap whole for refined grains in their diet. Dietary guidance and recommendations for whole grain consumption around the globe are inconsistent and often vague. The whole grain definitions working group was formed

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

develop a consistent definition of whole grain, both as an ingredient and also a whole grain food. The working group's consensus definition was developed through collaboration by private and public sector experts and recently published, a link to the paper is available at the WGI website. Promoting changes in public attitudes and behaviors around diet requires investment by government and authoritative bodies to help educate the public. The economics working group was charged with developing compelling evidence for the return on the investment policymakers and government stakeholders might recognize from their investment in programs promoting whole grain. Results from several health economic studies developed with members of the WGI economics working group will be presented. Promotion of whole grain requires consumer education; the communications working group was formed to increase awareness to whole grain and develop resources for use in educational campaigns targeting stakeholders and the public. Globally, grains represent the principal source of energy in the diet. The sustainability working group is exploring the value of whole grain as an efficient, quality carbohydrate that fits within planetary boundaries. Lastly, a whole grain recommendation working group is being formed with the task of identifying a pragmatic intake recommendation for whole grains. The introductory presentation of the Whole Grain Initiative organization, member composition, and mission and vision will provide the audience context for the presentations that follow by representatives of the individual working groups. The presentation will conclude with an invitation to engage during the conference and encourage the audience to join and participate.

Keywords: Whole grain, Policy, Health, Diet

Conflict of Interest Disclosure: Kevin is a nutrition scientist employed by General Mills

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SY(T6)11-02

Whole grains and whole grain foods - new global consensus definitions and the role of fibres and other bioactive compounds

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Whole grains are an important pillar of healthy and sustainable diets. However, actual intake in most counties remains well below recommended levels, due to a lower acceptance of products high in whole grains and a lack of clear definitions. Internationally accepted credible whole grain definitions are necessary to ensure that all global stakeholders have shared standards, and that consumers find them clear, credible, and useful. Such definitions may also play a role in a wider acceptance of whole grain products.

Based on widely accepted definitions and new developments, the Whole Grain Initiative published (*Nutrients 2022 14 (1)* https://doi.org/10.3390/nu14010138) generic definitions for whole grain as a food ingredient and for whole-grain foods, definitions ratified by the leading global scientific associations: International Association for Cereal Science and Technology (ICC), Cereals & Grains Association, and the Healthgrain Forum.

The definition of whole grain as food ingredient sets criteria for grain species to be included and for processes. All cereal grains of the Poaceae family used for human consumption are included as well as the widely used pseudo-cereals amaranth, buckwheat and quinoa, seeds that are similar in use and composition to cereal grains. For processing the definition requires that whole grains shall consist of the intact, ground, cracked, flaked or otherwise processed kernels. These other processes include fermentation, a technology increasingly used for preparing appealing whole-grain products.

For ensuring that whole grain is only indicated front-of-pack when the actual whole grain level is dietarily significant, the whole grain food definition sets a minimum level of 50% whole grain ingredients for calling a product a whole-grain food and of 25% for designating whole grain front-of-pack. These levels are calculated on a dry-weight basis. In this way whole grain can also be mentioned front-of-pack in products with a high moisture level (e.g. whole-grain porridge). The definition is also recommending the quantitative reporting of the amount of whole grain front-of-pack.

The Whole Grain Initiative urges adoption of these consensus definitions by national regulatory authorities and health promotion organisations worldwide. With a global definition setting credible minimum criteria, more lenient conditions, for example for the required levels of whole grains, should not be accepted.

In many dietary guidelines the presence of dietary fibre in whole grain products is highlighted for their contribution to meeting the recommended daily intake of at least 25-30g fibre, being adequate for normal laxation and contributing to reduced risks for lifestyle related diseases. Recommended intake levels for whole grains for realizing similar risk reductions range from 50 to 90 g/day, containing for wheat, the most widely consumed whole grain, 5–10g fibre. This indicates the beneficial role of the wide range of other bioactive compounds in whole grains such as minerals, vitamins, choline, betaine, phytosterols, tocopherols and last but not least polyphenols, compounds with anti-oxidant and increasingly recognized prebiotic properties. It should also be noted that such compounds, when present together in the food matrix may result in broader beneficial effects (Kristek A, Wiese M. *BJN*. 2019; https://doi.org/10.1017/S0007114518003501)

Keywords: Whole grain, whole grain foods, definitions, dietary fibre, bioactive compounds

SY(T6)11-03

Healthcare cost savings with increased whole grain intake

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Background: Dietary patterns including higher intakes of whole grain have been consistently associated with reduced incidence of cardiovascular diseases, type-2 diabetes, and certain gastric cancers, yet consumption is often low. Economic healthcare analyses are of interest, providing data to justify support for government guidance, policy, and consumer information. The aim of this research was to draw together analyses from the US, Australia, and Finland, assessing the potential healthcare and/or lost productivity cost savings associated with reductions in relative risk of these common chronic diseases.

Methods: To assess expected cost savings from increasing whole grain intakes over time, the American and Australian studies both employed arithmetic models whereas the Finnish study design included the more robust Markov-type cohort transition model with probabilistic sensitivity analysis (PSA). The studies utilised common input parameters from: 1) data on costs of healthcare (and if available, productivity loss) based on monetary figures by national healthcare authorities 2) relative reductions in risk of disease (with 95% confidence intervals) associated with specific whole grain consumption, as reported in meta-analysis studies 3) each study proposed pessimistic and optimistic scenarios 4) Three of the four studies applied a discounting rate to take into account the passing of time regarding costs.

Results: Healthcare cost savings ranged from USD $4516-$10,624/ person annually representing between 9.04%-16.89% of gross domestic product. Calculations based on the adult American population aimed to achieve the Dietary Guidelines for Americans recommendation 'make half your grains whole grain', and direct cost savings from CVD and CHD combined could reach USD $36 billion annually. In Australia, where only 27% meet the recommended 48g Daily Target Intake (DTI), if one-half met the DTI, there could be savings AUS $734 million ($560MM USD) and more than AUS $1.4 billion ($1 billion USD) in savings from T2DM and heart disease combined. In contrast, the Finnish population has a higher intake of whole grain, so modelling was based on a 10%-unit increase (from 70% to 80% of the population), and increasing the number of daily servings (i.e., two or more) among those who already use at least one serving a day, as well as the combination of those two scenarios on incidence of T2DM. This reduced total costs €286MM and 989MM ($340MM and 1.2 billion USD) over 10 years with additional improvements in Quality-Adjusted Life Years.

Conclusions: The analyses point to significant economic value in reaching target levels of whole grain consumption through simple nudges, exchanging refined flour products with as little as a slice of wholemeal/ whole grain bread or bowl of whole grain breakfast cereal daily. By focusing on the largest sources of whole grain within diets, for example, breakfast cereals and bread, the DTI could be achieved with a minimal burden on consumers. Future models of this type should consider age stratification and socio-economic status. Likewise, focusing on the lowest consuming age groups where there would be a greater benefit in correcting whole grain intake.

Keywords: whole grains, cardiovascular disease, diabetes, cancer, nutrition economics

SY(T6)11-04

Which food policies to promote whole grain consumption?

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Globally, consumption of whole grain is below recommended levels and low whole grain intake has been identified as the first dietary risk factor for global DALYs attributable to diet [1]. Several food policy tools exist that could help promote the consumption of whole grain. The symposium will cover several examples of food policies and programs that have targeted whole grain intake. Proposals from the Whole Grain Initiative will be presented, together with current gaps in knowledge that can prevent the adoption of policies.

Firstly, the promotion of whole grain in food-based dietary guidelines will be discussed, highlighting the variety of messaging on whole grain, in particular for quantitative intake recommendations. Secondly, a brief overview of educational and promotional campaigns regarding whole grains will be presented. The possibility of front-of-pack labelling including whole grain as well as whole grain content claims will be analysed in various jurisdictions. Finally, the challenge of reformulation will be assessed, and some concrete examples presented.

The coordination and harmonisation of such policies and the participation of all stakeholders is necessary to have an impact in terms of whole grain product availability and consumption. The example of the Danish Whole Grain Partnership will be presented as a successful campaign on whole grain. This public-private partnership led to an increase of the average whole grain intake within the Danish population from 36 to 82 g/day in 15 years [2].

By collecting scientific evidence on the health benefits of increased whole grain consumption as well as providing the means to translate such evidence into food policy tools (e.g. whole grain definitions), the Whole Grain Initiative's aim is to ensure whole grains are adequately and consistently considered in all food policies. A harmonisation of measures and guidelines on whole grain will enable an environment that incentivises manufacturers to propose products with higher whole grain content while providing clear and consistent messages to the general population.

Keywords: Whole grain, Food policy, Front-of-pack labelling, Food-based dietary guidelines, Public-private partnerships

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Conflict of Interest Disclosure: Gabriel Masset is currently employed by Nestle SA, and is a former employee of Cereal Partners Worldwide.

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Keywords: whole grain, nutrient profiling, consumer scepticism, front-of-pack labelling

Conflict of Interest Disclosure: Research funding was received from Cereal Partners Worldwide for NutriScore nutrient profiling work, but no other elements of this research

SY(T6)11-05

Aligning dietary guidance – including whole grain in front of pack labelling schemes

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Background and objectives: Intake of whole grains is associated with multiple health benefits however remains significantly below recommendations on a global scale. The priority worldwide for the consumption of less processed, whole-grain foods is recognised in national dietary guidelines. Whole-grain foods are encouraged together with high fibre grain varieties in almost all guidelines, with words such as “make at least half your grains whole grain”. Guidelines translate to front-of-pack labelling, including content claims, where manufacturers aim to guide consumers to choose whole grains. Food regulators develop nutrient profiling systems aimed to guide consumers in their food choices. Our work aimed to consider translation of the Whole Grain Initiative's whole-grain food definition[1] into practice. Specifically, we modelled whole-grain food definitions in nutrient profiling algorithms where whole grain was previously ignored and secondly, we explored how consumers might understand messages such as “whole-grain food” or “contains whole grain”.

Methods: We considered all foods in the 2011-2013 Australian Food, Nutrient and Supplement Database, applying cut offs from the Whole Grain Initiative's new whole-grain food definition of ≧25% and ≧50% whole grain in nutrient profiling systems, awarding higher points to foods with ≧50% whole grain[2]. Foods changing categories based on the new algorithm were explored. Focus groups with consumers explored their knowledge of whole grains, health benefits and their preferences for whole-grain labelling, which they considered likely to assist them in making positive food choices.

Results: Where whole grain is considered as a relevant measure of dietary quality, aligning nutrient profiling with dietary guidelines and including whole grain in profiling systems improved consistency with guidelines. Consumers had limited knowledge of whole-grain health benefits although they understood whole grains were positive dietary choices. They preferred specific messaging on packaging such as provision of a precise percentage of whole grain in a food and avoidance of more vague messages such as “high in whole grain”.

Conclusions: The modern consumer is sceptical of health messaging and therefore aligning of food regulatory systems (such as nutrient profiling and front-of-pack claims) may assist in promoting whole-grain intake. The global definition of whole-grain foods may assist in promoting consistent messaging.

SY(T6)12-02

Identifying socio-cultural conversion factors underlying maternal capabilities for child growth using ethnographic methods in Tanzania

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Background: The magnitude of childhood stunting in Tanzania is persistently high, even in high food-producing regions. This accentuates the critical need for a paradigm shift in Child Growth Monitoring (CGM) to a multi-dimensional approach that also includes the contextual information of an individual child and her/his caregivers. We engaged the Capability Framework for Child Growth (CFCG) to identify socio-cultural conversion factors that underly the mothers' capability to achieve their ability to ensure healthy child growth.

Methods: An ethnographic study was conducted in rural Tanzania to investigate the socio-cultural conversion factors shaping maternal capabilities for healthy child growth. Data for the study were collected through in-depth interviews, key informant interviews, participant observation, and focus group discussions with caregivers for under-fives. The topic guides with open-ended questions and probes were used. The issues related to conversion factors underlying maternal capabilities were captured using questions on the mother's daily responsibilities in the family, mothers' roles in promoting healthy growth, what mothers can do to make their children grow well, what caregivers think a mother would need to make their children grow well, the environments that contribute to mothers' ability and/or inability to provide good care for their children, and stories about moments when they wanted to take care of their children but could not. Both inductive and deductive approaches were used in the data analysis.

Results: Being able to feed children, being able to control and make decisions on farm products and income, and being able to ensure access to medical care emerged as important capabilities

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

for mothers related to promoting healthy child growth. A mother's capability to (breast)feed her infant was constrained by an interplay of multiple socio-cultural conversion factors, including (i) gendered patterns in childcare, (ii) the cultural belief that parents' resumption of sexual intercourse while a baby is still breastfeeding can harm child growth, (iii) cultural schema that a new pregnancy during lactation period spoils a mother's breast milk, (iv) the cultural schema that an infant's persistent crying at night indicates that the child is "born with hunger" and therefore cannot be satisfied by the mother's breast milk; and (v) the belief that a child's reduced interest in breastfeeding is caused by threats from *mdudu* (unseen evil spirit) residing in the mother's body. The patriarchal cultural norms restricted women's control of farm products and decision-making on household purchases and their capability to ensure a child's access to and utilization of medical care.

Conclusions: Our findings accentuate the need for the current child growth monitoring charts and tools to be aligned with the context, thus, include the indicators at the parental / household level. Capturing contextual information that embeds child growth would facilitate the identification of the root causes of childhood malnutrition, and would thus enhance the development of interventions that are effective in addressing inequalities among children. The CFCG could give direction to the paradigm shift needed for child growth monitoring, as it goes beyond biometric measures, and considers mothers' real opportunities for achieving healthy child growth.

Keywords: Capability approach, Conversion factors, Child growth, Growth monitoring, Ethnography

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SY(T6)12-03

Achieve scientific rigour using a participatory approach for identifying capabilities for child growth: an example of haor areas of Bangladesh

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Introduction: The multidimensional approach to child growth developed based on the constitutive elements of the capability approach, describes child growth as the achievement of a certain set of child and parental capabilities needed for a child to grow well.

Method and objective of the presentation: We used qualitative research in a participatory approach to identify capabilities in hard-to-reach *haor* areas of Bangladesh. In this presentation, we will illustrate how we assured scientific rigour and validated our initial findings.

Process of operationalizing capability approach: Firstly, we made use of criteria for identifying capabilities as suggested by Robeyns who is a renowned scholar on the capability approach. In addition, we had identified a universal list of capabilities based on a workshop with experts. Secondly, we conducted our research in two phases. In the first phase, we contextualised the universal list of capabilities for child growth in the context of Bangladesh, by incorporating feedback from the local experts that later shaped our interview guides to explore the contextual dimensions of child growth in *haor*. Then, we contextualised the capabilities in *haor* regions employing a participatory approach by combining doxastic and epistemic interviewing methodology. The doxastic interviews focused on "understanding" the interviewees that were done using specific interview guides for parents of children less than 2 years of age. The epistemic interviews were dialogues in which the interviewee and interviewer communicated from a position of equality to co-create knowledge and were done employing visual methods. An inductive coding method using an emic approach generated the codes close to the actual data. For example, in response to the question, what kinds of abilities a mother or a father needs to have to take good care of his/her children, a participant said: "...*She must have maya (affection) and mohabbat (love) for her child. If she doesn't have that she would not able to take care of her child". We coded this response as "mother's capability to express maya and mohabbat".* When the participants pointed to the importance of the collective capabilities of all household members, we categorized that *"household's* capability"; e.g., "*household's* capability to overcome the struggle with the earth to keep the child neat and clean". The stories for each of the capabilities that emerged from the doxastic interview were later discussed with the participants using the visual method. For example, a drawing of "a husband attempting to beat his wife" was used to invite people to talk about a mother's capability to stay away from domestic violence in connection with child growth. Thus, the analysis provided nuance to the capabilities and generated a set of valid lists of capabilities at child, mother, father, and household levels that affect children's healthy growth.

Conclusion: Our example will provide guidance to nutritionists and capability scholars on how to apply a capability approach in a participatory way in a vulnerable setting while assuring scientific rigour and meeting requirements for validity, by combining doxastic and epistemic interview methods and by applying an emic approach.

Keywords: capability approach, participatory approach, haor, child growth, Bangladesh

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)12-04

Constructing a Multidimensional Index of Child Growth for Ethiopia, Perú, India and Vietnam: Quantitative results

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Background and objectives: Child-specific indicators were developed by UNICEF and by researchers worldwide to capture the physical causes of malnutrition. The objective of the research was to calculate a Multidimensional Index of Child Growth (MICG) with physical and non-physical indicators that measure the direct and indirect causes of malnutrition for children living in four countries: Ethiopia, India, Vietnam, and Peru.

Methods: The MICG is based on the operationalization of the capability approach for children and the theoretical and conceptual framework of child growth formulated by the members of the Task Force "Toward Multidimensional Indicators of Child Growth and Development". Bayesian methods were applied to recover children's capabilities from observed indicators.

Results: Poorer physical health, less freedom from paid and unpaid work, and less freedom from domestic tasks was found for children living in rural areas of Ethiopia, Vietnam, and Peru. In Vietnam, female children in rural areas not only have poorer physical health but also lower opportunities for multidimensional growth.

Conclusions: To properly identifying children that could be left behind during the development process it is necessary to enrich the datasets that aim to measure the situation of children worldwide.

Keywords: Child growth, Multidimensional indexes, Capability approach, Bayesian methos

Conflict of Interest Disclosure: None

Further Collaborators: Jonathan Wells, Paul Anand, Alusio Barros, Ali Dhansay and the members of the IUNS Task Force: "Toward Multidimensional Indicators of Child Growth and Development".

SY(T6)12-05

Implementation of the multi-dimensional index for child growth - Implications for policy and practice

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Background: As a Task Force we worked on the development of a Multi-dimensional Index for Child Growth that is based on knowledge on child and parental capabilities. As a first step we conducted ethnographic research in Tanzania and in Bangladesh to obtain the perspectives of local populations. Next, we constructed an index for child growth using data from the Young Lives Survey of the University of Oxford. This survey contains information on the physical dimension of child growth and on the social and cultural domains, of the contexts in which children live from Peru, Ethiopia, Vietnam and India. A spiderweb with 14 dimensions was used to compare multidimensional child growth between those countries. Bayesian stochastic frontier analysis was applied to assess children's and parental capabilities for child growth. Stakeholders from international organisations and universities were also involved in the process of developing the index.

Objective: A next step will be to test the index in the field, as a tool to make comparisons between countries, to monitor achievement towards SDG targets, to evaluation interventions, and ultimately to inform the development of manuals for child growth monitoring so that malnutrition can be combatted in all its forms at the community level as well. The spiderweb will be tested as a communication tool at wellbaby clinics.

We identified a number of challenges for implementation of the index as a measurement tool: 1. Lack of quantitative data on the root/indirect causes of malnutrition; 2. Resistance towards complex indices on the part of intended program users, and the need to simplify the index; 3. Competition with other frameworks planners are familiar with. The Task Force will use concepts from implementation science to study these challenges and ways to overcome them and identify compromises to improve current mono-dimensional measuring tools. The Task Force will then test the index as a monitoring and evaluation tool in nutrition programmes, for example, in Bangladesh, as this is one country where there is a depth of insight related to parental capabilities for child growth.

Keywords: Child growth, Multi-dimensional index, Monitoring & evaluation, Inequalities, Implementation

Conflict of Interest Disclosure: The authors have no conflicts of interest to declare.

Further Collaborators: Enrica Chiappero-Martinetti; Shirish Darak; Zaina Mchome; Chumki Chakraborty; Sridhar Venkatapuram

SY(T6)13-01

Food safety and nutrition: exploring the linkages

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1. GAIN (Switzerland)

To further human health, diets must be comprised of foods that are both nutritious and safe: that is, they must enable people to meet their micro- and macronutrient requirements (while not exceeding them) and not expose them to foodborne illness. Currently, this is not the case for a large share of the global population—burdens of malnutrition and of foodborne disease remain large. The two challenges are interlinked: efficient and effective food-systems action to improve nutrition and reduce foodborne disease requires synergies that seek to improve access to nutrient-dense foods while simultaneously improving their safety. However, the two issues are often addressed in isolation. They are not monitored, analysed, or tackled jointly, be it in legislation, guidance, or research. This presentation will examine how food safety and nutrition are inextricably linked, focusing on four pathways: physiological, consumer behaviour, food supply chains and markets, and policy and regulation. It will discuss the implications of a more interlinked view of food safety and nutrition for policy and programming.

Keywords: food safety, nutrition

Conflict of Interest Disclosure: None

Further Collaborators: Elisabetta Lambertini, Bonnie McClafferty, Lynnette Neufeld, and Caroline Smith DeWaal contributed to developing the framework on which this presentation draws.

SY(T6)13-02

Research Strategies Addressing Food Safety in LMICs

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Foods can be nutritious and available, but if those foods are unsafe, there is no food security. Contaminated foods are estimated to sicken 600 million people a year, contributing to impaired growth and development in children, food insecurity, and barriers to entry into the global food trade. By investing in data-driven approaches to identify the key points for intervention, we support countries in transforming the handling and processing of foods at the household, farm, and market level. Funded by the United States Agency for International Development (USAID), the Feed the Future Innovation Lab for Food Safety (Food Safety Innovation Lab) is jointly managed by Purdue and Cornell Universities. We leverage extensive experience in international food safety research, education, and extension to develop and manage a portfolio of food safety and capacity development projects to meet the following objectives: (i) Increasing awareness of food safety, (ii) Enhancing capacity to conduct food safety research, (iii) Developing policies that enable conditions for food safety research, translation, and practice, and (iv) Accelerating translational research technologies and practices for households, communities, and the food industry. In this presentation, we will showcase the Food Safety Innovation Lab ongoing research portfolio in Bangladesh, Cambodia, Kenya, Nepal, Nigeria, and Senegal, highlighting the importance of local partners and university collaborations. We will also highlight major outcomes from a USAID-funded COVID-19 response program to improve awareness and safety among food industry professionals in LMICs. Lessons learned, barriers, and opportunities will be shared.

Keywords: Food safety, Research for Development, LMIC, nutrition, partnerships

SY(T6)13-03

How consumer behaviour interface food safety and nutrition: a case of the Ghanaian consumer

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Background and objectives: Consumer perceptions of food safety affect food choice. Food safety perceptions are shaped by consumer experiences, food environment, subjective food safety knowledge, food safety communication through popular media or extension of food safety knowledge or experiences of family, friends and loved ones. These perceptions influence consumer behaviour and diet choices either positively or negatively and they have overall implications on the nutritional status of the consumer. There is little evidence of the interplay between nutrition and food safety. This study presents pieces of evidence from Ghana on the linkage between food safety and nutrition in the context of consumer behaviour.

Method: Desk top review on available studies conducted in food safety and nutrition in Ghana.

Results: A recent study that investigated consumption of traditional dairy products in fifteen dairying communities in Ghana, revealed that poor safety perception of the traditional dairy products (boiled milk, *brukina and wagashie)* hindered patronage and consumption in the dairying communities. One of the focused group participants suggested that "his brother's wife drank *brukina* and died, so in their household no one drinks *brukina*." *Brukina* is a fermented milk beverage mixed with cooked agglomerated millet. It is consumed as a snack in Ghana and neighbouring countries. Microbiological survey of these

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

products revealed that boiled milk and fried *wagashie* were erroneously perceived as unsafe and thus these products are underutilized although they are affordable, nutritious and safe. Another food product commonly consumed nationwide, is kenkey. Kenkey is a soft fermented maize dumpling that are rolled into balls and cooked in maize husks (Ga kenkey) or plantain leaves (Fante kenkey). Kenkey is a common source of energy for most Ghanaians as it is a staple, affordable and accessible as a street vended food. A study in year 2000 revealed high levels of aflatoxins in kenkey which was communicated in common press as "*kenkey causes cancer*". This was very alarming to the public, and many averted consumption of kenkey. However, risk communicators and relevant government agencies intervened. Aflatoxins in grains and legumes, which are staples for Ghanaians and other West African countries, continue to present significant chemical hazards in our food supply. Studies in four villages in Ghana identified AFB1 albumin levels ranging 0.12-3.00pmol/mg among 140 participants and AFM1 ranging undetectable levels – 11562.36pg/mg in urine samples among ninety-one participants. There have since been various intervention efforts to minimize risk. There are evidence of several other food safety concerns the influence consumer choice. For example, consumers in Ghana worry about pesticide residues in green leafy vegetables consumed raw or minimally processed, and risk of cholera, typhoid fever, diarrhoea and other forms of food poisoning associated with fast foods and ready to eat foods. One typical street vended food, known as *waakye*, is made up of rice, beans, vegetables, sauce and eggs, fish or meat. *Waakye* is common in urban and peri-urban communities in Ghana, but it is associated with cholera. Most consumers of waakye are aware of this risk but they conduct their own individual risk assessments in deciding whether, and from who, to purchase this delicacy. **Conclusion:** Food safety influences consumer choice of diets and can thus enhance positive or negative nutritional outcomes. Further evidence is needed to fully understand the bidirectional linkages between nutrition and food safety. Such evidence will support appropriate programming and policies to improve food safety and nutrition outcomes.

Keywords: Food safety, Nutrition, Consumer perception, Consumer behaviour

Conflict of Interest Disclosure: There is no conflict of interest.

SY(T6)13-04

Food Safety in Street Food in India

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India has innovated and created a unique model for the safety of street food. This model adopts a 5-E (Engage-Excite-Empower-Enable-Entice) approach. Training and capacity building and third-party audits are important parts of the protocol. Local municipal authorities and state administration provide requisite civic infrastructure. This has created a mutually reinforcing process of change and created a strong and sustainable food safety culture in India.

Keywords: food safety, street food

SY(T6)13-05

Commentary – What is the way forward for improving food safety, in a nutrition-sensitive way, via policy and programming in LMICs?

Carol J Wilson[1]

1. USAID (USA)

USAID recognizes the need for a holistic, nutrition-sensitive food systems approach that addresses food safety risks and allows our investments in programs around the world to achieve inclusive and sustainable progress. We encourage strengthening the multi-sectoral enabling environment for safe, nutritious foods. We also emphasize collaboration with governments, the private sector and all stakeholders to support the most vulnerable, but in particular women and children under five.

Keywords: Nutrition, Multi-Sectoral

SY(T6)14-01

Current status and issues of national nutrition monitoring in German-speaking countries

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Regular monitoring of the population's health and nutrition status is important to identify critical nutrients and risk factors

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

for obesity and chronic diseases as well as population groups with specific nutritional risks. Nutrition surveys provide the basis for the development of nutrition and health policies to address problems. The first national nutrition survey in the German-speaking countries, the German National Food Consumption Survey (Nationale Verzehrsstudie I, NVS I) dates to 1985-1989. In a sub-sample, biochemical parameters were assessed. Twenty years later, from 2005-2007, the NVS II, was based on dietary assessment only. A follow-up (NVS III) planned for 2023 will include analyses of critical nutrients in blood and urine. It was scheduled for spring 2020 but was postponed due to the COVID-19 pandemic. The Austrian Study on Nutrition Status (ASNS) started in 1991 and was first published in 1998, with follow-up reports in 2003, 2008, 2012, and 2017 (adults only). Among these, ASNS 1998 and 2012 included biochemical analyses of nutrients. Switzerland reported consumption estimates based on agricultural statistics until 2012. In 2014/15 the first Swiss national nutrition survey (menuCH) was realised in adults relying on dietary assessment only. A survey with children and adolescents (menuCH-Kids) planned for 2023 will include biological samples. In general, nutrition monitoring faces challenges to depict an increasingly complex and rapidly changing nutrition situation. One challenge is the increasing differentiation of food market and eating situations, which may be addressed by digitalisation of dietary assessment. This should include barcode scanning and photographs of packaged products to support assessment of portion size and food composition of branded foods. Moreover, harmonised European Nutrition Monitoring needs to be addressed. For the estimation of nutrient intake of the population, nutrient databases continually need to be further developed, e. g. secondary plant compounds should be included. Another issue is the underrepresentation of population groups like older persons (≥ 80 y), pregnant/lactating women and ethnic minorities in nutrition monitoring of German speaking countries. Besides a stronger focus on biochemical analyses and improved dietary assessment, upcoming nutrition surveys will also have to focus on environmental aspects of nutrition and the food system.

Keywords: National, Nutrition monitoring, Germany, Austria, Switzerland

SY(T6)14-02

National health and nutrition surveys in Finland

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Altogether 13 health surveys including a dietary component in a sub-sample, have been carried out in Finland, since the late 1960's. One driving force in the long history of national health and risk factor monitoring in Finland has been the highest coronary heart disease mortality among men in the world. Health examination surveys with a follow-up, cross-sectional health and risk factor monitoring surveys, and postal surveys on health behaviour have been included.

The National FINRISK Studies carried out every 5th year by the Finnish Institute for Health and Welfare (THL) have included a dietary survey in a 30% sub-sample. For over two decades, food consumption data have been collected using an in-house developed, computerized data collection and calculation software (Finessi), with the national food composition database Fineli® incorporated. In addition, a validated food frequency questionnaire (FFQ) has been used for dietary data collection in population surveys.

The most recent health examination effort, the FinHealth Study (N=10247, > 18 years) was carried out in 2017 in a nationally representative random sample to produce reliable and up-to-date information on health, well-being, health behaviour and functional capacity as well as their determinants in the Finnish adult population. The FinDiet 2017 dietary survey was carried out in a sub-sample according to the harmonized EU Menu methodology recommended by the European Food Safety Authority (EFSA).

Today, the diverse background data, measurements and samples collected during the past decades are nationally and internationally used to carry out complex sets of analyses to provide information for health and welfare monitoring and policy planning purposes and to further harmonize health surveys. Register based follow-up has further increased possibilities for services development and scientific research. In the future, the main aim is to use different modules of data collection to cover the national health and dietary data needs. Utilization of register information in monitoring the health and well-being of the population may be increased. A nationally representative nutrition survey among children and adolescents has been lacking and is a major priority in the coming years. In the coming surveys, the participation rate continues to be a major challenge. Renewal of the dietary research infrastructure is ongoing.

Since the early 1970's in Finland, the reduction of cardiovascular disease risk factor prevalences have been pronounced due to a decrease in smoking prevalence and blood pressure levels as well as improved serum lipid values. These developments have resulted in a major decrease in cardiovascular disease morbidity and mortality. On the other hand, during the past 25 years, a significant increase in both obesity and Type2 diabetes has been observed. The diet of Finnish adults has generally improved. However, the quality of fat and carbohydrates as well as the high salt intake and low intake of folate remain key challenges. Vitamin D and iodine intakes have improved due to updated food fortification programs. The main disparities in nutritional adequacy are seen between genders and less between socio-economic population groups.

Keywords: Health and risk factor surveys, Dietary surveys, Biomarkers, FinHealth Study, FinDiet Survey

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)14-03

Nutrition Monitoring in the United States -- What We Eat in America, National Health and Nutrition Examination Survey

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National dietary surveillance of the United States (U.S.) population is essential for informing and evaluating national policies in food and nutrition. Continuous monitoring of the dietary patterns of the U.S. population is critical to evaluate dietary status and diet-related health characteristics and to identify future Federal nutrition and related regulatory and program needs. National dietary data collection in the U.S. is accomplished by one national food and nutrition survey, What We Eat In America (WWEIA), launched in 2002 through the collection mechanism of the National Health and Nutrition Examination Survey (NHANES). WWEIA consists of 2 recalls on 5,000 respondents per year, one in-person and the second by telephone. The two components of dietary data collection in WWEIA are U.S. Department of Agriculture's (USDA) validated 24-hour dietary recall instrument, the Automated Multiple-Pass Method (AMPM) and its companion component, the USDA Food and Nutrient Database for Dietary Studies (FNDDS), used to convert foods and their amounts reported in the AMPM into gram amounts and determine their nutrient values. **The design of the AMPM**, based on the guiding principles of enhancing accuracy and reducing respondent burden, includes multiple recall strategies and memory cues within its structure of 5 steps that progress in logical order. USDA's AMPM and its related data processing programs and databases are made available for use by other government agencies and by partial support from outside research institutions through collaborative agreements. The WWEIA, NHANES data are made publicly available, providing the critical linkage of data on food and beverage intakes to data on health status. Survey products including data tables, data briefs, and research papers summarize major findings. Additional specialized survey databases provide detailed characteristics to evaluate dietary intakes based on dietary guidance or retail food commodities. The survey data and research products are available at the Food Surveys Research Group website at www.ars.usda.gov/nea/bhnrc/fsrg. The AMPM, dietary data collection methodology and instrumentation, dietary databases, data review and public release, and data reporting will be detailed. Advancements in dietary data collection and related food/beverage databases to meet data user needs will be highlighted.

Keywords: What We Eat In America, dietary surveillance, nutrient intake

Conflict of Interest Disclosure: no conflict of interest to disclose

SY(T6)14-04

Current State and Issues of National Health and Nutrition Survey in Japan

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The National Health and Nutrition Survey, Japan (NHNS-J) is a nation-wide household-based survey conducted annually since 1946. Participants are household members aged 1 year or older of households living in the 300 unit blocks (about 5700 households and N=15000) that were randomly selected from the unit blocks of the Comprehensive Survey of Living Conditions of each year except for 2012 and 2016, where an expanding survey was conducted. It currently consists of three components, the one-day dietary survey, physical examination survey, and the lifestyle questionnaire survey. The surveys were conducted in November except for 2012 and 2016 where it was conducted from 25 October to 7 December and 1 October to 30 November, respectively. Overall response rates for the NHNS-J ranged 44.4% (2016) to 68.6% (2003). Dietary intake data were collected using a 1-day semi-weighed household-based dietary record, and food consumption is recorded for a usual day excluding trip or festivity days. Trained fieldworkers (mainly registered dieticians) at the public health centers in charge, give instructions to participants about the survey purpose and how to complete the dietary record. The main record-keepers in a household (members who are usually responsible for preparing meals) were instructed to weigh all the foods and beverages consumed by the household members and record their names and weights on open-ended recording forms, including the amounts of food waste and leftovers, in a separate sheet for breakfast, lunch, dinner, and snacks. The approximate proportions of the food taken by each household member for a shared dish is recorded so that the dietary intake of each member could be calculated. Trained fieldworkers visit each household and checked the completeness of recording forms and, if necessary, confirmed portion sizes using commercially available food models or food booklets, and corrected any missing information. After intensive checking, the dietary intake data is collected through the online data entry system, named “Shokujishirabe” (meaning meal checker). The current survey method requires much manpower, as well as experienced fieldworkers (dieticians) in conducting in-person dietary surveys. Already before the COVID-19 pandemic since 2020, the survey faced difficulties in collecting data from young, working age participants. Since then, it has become extremely difficult to conduct home visits as well as physical examinations. In this lecture, we report the current difficulties we face in conducting nation-wide dietary surveys, as well as applying other methodologies.

Keywords: national survey, diet, nutrition

Conflict of Interest Disclosure: There are no conflicts of interest to declare.

Further Collaborators: Drs. Mai Matsumoto, Ryoko Tajima, Tomoko Aoyama, Xlaoxi Yuan, and Emiko Okada

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)15-01

Inflammatory Food Consumption and Age-related Hearing Impairment in a Prospective Observational Cohort: Results from the Salus in Apulia Study

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The aetiology of age-related hearing loss is extremely complex and currently being researched in modern science. A growing body of data has connected age-related hearing loss to various aging conditions, including cerebrovascular diseases (CVDs) and physical frailty. In older persons, the prevalence of age-related hearing loss or age-related central auditory processing disorder (CAPD) is higher. These disorders frequently coexist, implying some similar underlying mechanisms, such as systemic inflammation. To reduce the occurrence of ARHL and CAPD, preventing systemic inflammation and microcirculation anomalies could be a public health strategy. It is also well documented that the consumption of unusual foods and specific dietary patterns can reduce or raise systemic inflammation. As a result, nutritional variables may play a role in repairing the first damage to the hearing before it becomes irreversible, and so maybe a step toward preventing hearing loss. This study aimed to see if eating pro-inflammatory foods was linked to age-related hearing loss (ARHL) and age-related central auditory processing disorder (CAPD) in a population-based cohort of older adults from a Mediterranean area.

Participants of the present study were enrolled from the electoral rolls of Castellana Grotte, Bari, Southern Italy. The baseline data were recorded from 2003 to 2005, and the follow-up data from 2013 to 2015. All those studies were conducted within the “Salus in Apulia Study” a public health survey funded by the Italian Ministry of Health and Apulia Regional Government and conducted at IRCCS “S. De Bellis” Research Hospital. We selected 734 participants (425 males). Dietary habits were assessed by a Food Frequency Questionnaire. Peripheral ARHL was defined with a pure tone average threshold greater than 40 dB hearing level in the better ear. CAPD was defined with a Synthetic Sentence Identification with Ipsilateral Competing Message (SSI-ICM) or a Contralateral Competing Message (SSI-CCM). The association between ARHL or CAPD and food groups and micro/macronutrients was examined with adjusted logistic regression models.

There were mean differences in terms of increased consumption of fruit juices (10.0±5.9 vs 5.6±2.0), sugary foods (15.2±4.3 vs 11.8±1.9), caloric drinks (16.2± 16.2 vs 9.2±5.6), beer (39.7±42.2 vs 27.3±23.9), and spirits (2.5±2.9 vs 1.5±1.4) in the ARHL group compared to the normal hearing group. Only a significant increase in vitamin A dietary intake was evident in the normal hearing group (1177.7±99.7) compared to the ARHL subjects (1042.0± 116.6). In the CAPD group compared to the normal hearing subjects, there were mean differences in terms of increased consumption of grains (215.2±35.2 vs 196.2±37.5), sugars (15.1±4.5 vs 11.7±1.9), spirits (1.8±2.3 vs 1.1±0.7) and in term of decreased consumption of fruits (535.7±80.3 vs 651.4±98.1).

Anti-inflammatory dietary patterns and the avoidance of inflammatory foods such as sugars and alcohol can be part of a healthy lifestyle program for ARHL prevention. Consuming vitamin-rich foods, such as fruit, while avoiding sugar-rich food, alcohol, and grains can help to prevent CAPD.

Keywords: age-related hearing loss, population studies, sugar, alcohol, inflammation

SY(T6)15-02

The role of diet in the increase of cardiovascular risk in the prospective cohort of Moli-Sani Study

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Poor diets are responsible for more deaths than any other risk factor globally, and are the leading cause of obesity and non-communicable diseases. In light of this, much of the research efforts in large-scale cohort studies are directed to disentangle the association between diet and disease risk on a long term. The Moli-sani Study is one of the largest population-based cohorts established in Europe in the last decades. It consists of 24,325 men and women (aged more than 35 y) who between 2005-2010 were randomly recruited from the general population of Molise, a Southern Italian region, with the purpose of investigating genetic and environmental risk factors in the onset of major non-communicable diseases, with a special attention being paid to diet and dietary habits of the population. The research questions have been mainly directed to analyse the association of a traditional Mediterranean diet, which emphasizes high intake of plant foods, olive oil, high-to-moderate intakes of fish and seafood, moderate consumption of poultry and dairy products, low consumption of red meat, and moderate intake of wine during meals, with different health outcomes, in particular cardiovascular disease (CVD). Results from analyses conducted in this cohort point to a reduced mortality risk in the general population, but also in some high-risk groups, as the elderly, people with type 2 diabetes and also for those with pre-existing history of CVD. Of interest, our data also suggest that the protection associated with a close adherence to a Mediterranean Diet may vary substantially across socioeconomic groups, and therefore suggesting a role for food quality beyond the quantity of food consumed. More recently, analyses conducted in the Moli-sani Study were aimed to investigate the potential implications of food processing to human health. Actually, the diet–health relationship has been traditionally explained almost exclusively by food composition, therefore leading to recommendations of reducing sugar, salt and fat in the diet, with no or little attention paid to degree of food processing. However, such a nutrient-driven approach, also referred to as the ‘nutrient gate', has some important limitations, since other aspects in the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

diet-health relationship are increasingly acknowledged as important as nutrients in shaping health risk at population level. More recently, data from the Moli-sani Study reported a 58% increased risk of CVD mortality associated with an elevated UPF intake, as compared to less UPF, in the general population, and this was confirmed also among individuals with pre-existing CVD. Of interest, these associations were independent from the overall diet quality and this means that the detrimental health impact of UPF should be understood as net of its nutritional quality. If on the one hand it is undeniable that these foods are nutritionally inadequate (i.e. having a low content of fibre, vitamins and other nutrients, while being rich in calories, unhealthy fats and salt), on the other it is necessary to search for other possible mechanisms, other than the nutrient pathway, which may explain the link between heavy UPF intake and non-communicable chronic diseases.

Keywords: Mediterranean Diet, non-communicable chronic diseases, cardiovascular disease, ultra-processed food, public health nutrition

SY(T6)16-01

Scoping the potential to integrate local agriculture in the provision of food in schools in the Pacific Islands

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Food provision in schools based on home-grown models can serve as platforms for food system transformation, while simultaneously improving the quality of education. Locally grown and procured food is a nutritious, healthy, and efficient way to provide schoolchildren with a daily meal while, at the same time, improving opportunities for smallholder farmers. Despite the significant global development of home-grown school feeding types of approaches linking to local producers and aimed at improving farmer livelihoods and other related job creation, there has been very little attention on these models in the Pacific Islands region or indeed on school feeding programmes in the region generally. The aim of research is to provide an understanding of the current extent and status of school food provision and environments in Pacific Islands countries, with a focus on better understanding the enabling policy environment, institutional and farmer capacity to better support the integration of local agriculture into school food provision. A desk-based scoping study and interviews will develop an understanding the current state of integration of local agriculture into school food provision in the region, and the development of a database of activities. Based on these findings, a subset of countries will be selected for a deep-dive of the policy landscape to identify policy enablers and to document case studies. Furthermore, sustainable options for integrating local agriculture into school food provision and recommendations for action and research opportunities will be identified through workshops and discussions with key stakeholders and organizations. This symposia presentation will provide a description of the current landscape, an overview of the policy enablers and research opportunities identified.

Keywords: Oceania, Food systems, Education, Health

Conflict of Interest Disclosure: This work is funded by the Australian Centre for International Agricultural Research, (HORT 2021 159).

SY(T6)16-02

Morobe School Garden's potential to Provide Nutritious Food: A pilot

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Papua New Guinea (PNG) has some of the highest global rates of chronic child malnutrition. At the same time, the majority of PNG youth are not attending school, with the primary school net attendance ratio for primary school students at 50%, dropping to 21% for secondary school. The combination of malnutrition and poor formal education results in significant economic impacts, including loss of productivity and intergenerational poverty. As well, employment prospects are poor for the school leavers who constitute 60% of the population. PNG youth are struggling to complete their schooling, with 80% pushed out of the formal education system annually. Agriculture is the main livelihood for rural populations hence if the current trend continues, rural youth are likely to similarly depend on agriculture-based livelihoods. Schools provide clear entry points for both agriculture and nutrition interventions, yet the school system no longer prepares them well for agriculture-based livelihoods, nor does it seek to engage their interest in agriculture. Agriculture and nutrition have been a part of PNG's curriculum since before Independence, including versions of the school garden (SG) model. However, these parts of the education system have fallen into disrepair due to resource and capacity constraints. Revitalizing of school farms and teaching students practical farming skills would help address the lack of agricultural extension services in PNG. The Morobe School Gardens Project implemented in Morobe province, PNG, is based on the fundamental concept which provides a model to promote school gardens as a way to engage youth in agriculture. The project established integrated-gardens at the primary and secondary schools and education resources for teachers to utilize the gardens to deliver the mechanism. The pilot project implemented so far 15 gardens, 10 chicken sheds, and 1 fish pond in 15 primary and secondary schools. A survey was administered to 185 students and 6 teachers from 2 schools to provide data on understanding the school food environments, knowledge, and attitudes regarding nutrition and agricultural livelihoods, and students' diet quality through a qualitative 24hour recall. Boarding school menus were documented, and

recommendations on how to improve their nutritional quality using the garden outputs were developed. Cost-benefit analysis models were developed to evaluate how these gardens could be financially self-sufficient, and their capacity to provide surplus produce and/or income to provide and/or procure nutritious foods. These data were used to develop a set of school food provision models utilizing the school garden. The project also took a proactive role in engaging the PNG Government on the topics of school gardens, nutrition, and the SG model, which is now recognized by the PNG Government and was endorsed in 2021 with an SG Policy. In this connection, the model SG project aims to bridge the gap in the curriculum in agriculture and nutrition education and low-cost agriculture production as a basis for a school food provision model.

Keywords: nutrition, school gardens, agriculture, school garden policy, education

SY(T6)16-03

Palau's School Service Program (Food Service Program at a Glance)

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The Food Service Program (FSP) is a Program that provides food and kitchen supplies to all eighteen public schools under the Ministry of Education in the Republic of Palau. The idea is not only distributing food supplies to cafeterias where about thirty cooks prepare hot meals for students, but also providing cook workshops to enhance their cooking skills and services while utilizing local and nutritious food.

However, about seven years ago when I came on board, there was a limited budget of about $821K per year (current budget is $946K per fiscal year), serving all public elementary schools while Palau High School meals were from restaurant vendors, which was using a big chunk of the limited yearly budget. There was barely local food utilized in the menu, as well as limited usage of fruits and vegetables. Thus, the direction taken was figuring out how to increase the limited budget while being creative enough to accomplish objectives of a healthy eating for all public school students. Several approaches had to take place to achieve this task.

For instance, study was made and concluded that by hiring cooks to prepare meals, it would be more cheaper, so the kitchen was constructed as well as five cooks hired to prepare meals. Thus, the budget saved every month was then used to buy local vegetables and fruits as well as store food items when necessary. FSP realized that in order to provide nutritious food, the cooks have to be trained to cook these healthy food items. Thereby, Nutritionist volunteers (one from JICA and one from ICDF-Taiwan) were requested to come on board and conduct cook workshops and trainings to enhance the cooking skills and improve nutrition and sanitation management. In addition, the Nutritionists also conduct cafeteria inspections as well as food education for the students and parents to promote healthy eating in the school setting. FSP conducts cafeteria visitations and monitoring in order to make sure that the given food supplies are being utilized.

Moreover, collaboration and networking are important in order to request partner agencies to help with technical assistance as well as providing professional development. Alongside these solutions, FSP has reached out to fishing cooperatives in order to promote sustainable fishery, as well as having local partners to provide local fish, taro, fruits and vegetables, eggs and other food that are cheaper and lessen the carbon footprints.

The major results of these endeavors are as follows:

· By utilizing the local food systems, FSP is saving its budget in order to promote yearly improvements.

· Nourishing children with local nutritious food has brought awareness to student healthy eating.

· Yearly budget has increased to $946K in order to provide student breakfast.

· Nutritionists also conduct nutrition education for the community.

· Health and nutrition initiatives are currently being developed due to networking with partner agencies in the government and non-government sectors.

The results have been positive and effective. FSP will continue its important mission to nourish children through healthy eating while sustaining local food systems.

Keywords: Food Service Program (FSP), Food supplies, Nutrition, Local food

SY(T6)16-04

Green Schools – nutritional food security in schools through a sustainable organic farming program in Beqa Lagoon, Fiji

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Pacific Blue Foundation has established the 'Beqa Lagoon Initiative' which forges strong partnerships to implement cross-sectoral sustainable development of a remote Fijian seascape that is home to 1500 indigenous people. The Green Schools program is a fundamental element of the initiative.

The Green Schools Program has been piloted at remote boarding school locations on two Islands in Beqa Lagoon and has been successful in integrating small commercial scale organic farming with the school curriculum. The project has demonstrated how the nutrition of school age students can be directly and tangibly improved using this practical educational model.

School age children in remote islands of Fiji have limited access to fresh produce due to isolation and costs. As a result, their diets consist mainly of rice, cassava and tinned food, with occasional leaf vegetables provided by student parents. This has led to malnourishment of youth attenuating from vitamin and mineral deficiencies. As part of the Green Schools Program in

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Beqa Lagoon, organic farms have been established in and around school compounds and students are educated in the application of traditional and innovative agricultural practices to cultivate high-yielding nutritional crops. These crops include cabbage, beans, lettuce, eggplant, tomato and cucumber which are attended by students supervised by dedicated community members and the academic staff, harvested and cooked at the school's kitchen and consumed during school hours. As part of the school's activities, students are responsible for expanding and maintaining the school's organic farm, taught the nutritional value of consuming a range of fresh vegetables and the importance of a healthy, balanced diet.

The Green Schools Program has improved the health, nutrition and well-being of school age children and the broader islands' community in the following ways:
· Direct nutritional benefits associated with consuming a wide variety of organic vegetables during school hours

· Integrating a variety of vegetables into the staple diet of children that they otherwise would have limited access to

· The opportunity to sell excess local produce, therefore providing financial-returns to the school supporting the farm maintenance

· Upskilling students with farming skills resulting in positive flow on effects as skills and learnings are shared with the farming community of the islands

· Providing the capacity and capability for students to grow commercial scale fresh produce using an organic closed system model therefore enhancing long-term income generating opportunities for youth as they transition into young adults

· Provision of sustainable livelihoods in the form of high yielding organic farming that can replace unstainable fishing and agriculture therefore enhancing environmental and ecological outcomes.

This presentation will showcase the successes of the Green Schools program and highlight the importance of engaging students through hands on learning opportunities and practical farming solutions to improve nutrition. It will explore the important roles of the different stakeholders play in the inclusive education system of remote island settings in assuring the long-term educational and nutritional benefits for children and youth so they can become the role models and custodians of community health.

Keywords: Food security, Nutrition, Environment, Governance, Sustainability

Conflict of Interest Disclosure: None

Further Collaborators: Isimeli Loganimoce: Fiji Locally Managed Marine Areas Network; Sarah Burkhart: University of the Sunshine Coast; Jodi Smith: Matanataki

SY(T6)17-01

Framing food choice, creating demand for healthy diets, and engaging with actors to respond to emerging nutritional challenges

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Background and objectives: Globalized food systems, urbanization, climate change, and expansion and alteration of retail markets are rapidly changing food environments in low- and middle-income countries. Sub-Saharan Africa and South Asia are experiencing unprecedented economic growth with concomitant increases in wages and availability of consumer goods, including locally and industrially processed foods and beverages of low nutritional value. Displacement of healthy foods threatens the development of a high burden of nutrition-related non-communicable diseases such as diabetes, hypertension, and cancer. The objective is to frame why countering this trend requires understanding how and why people make food choices in the context of rapidly changing food environments; how to assess food environments; how to create demand for healthy diets; and how to engage among nutrition, health, public, and private-sector actors to assess and respond to this emerging nutritional challenge.

Methods: Recent developments in thinking and empirical research about food choice, demand creation, food environments, and engagement in countries were reviewed.

Results: Understanding how and why people make food choices in the context of rapidly changing food environments requires quantitative and qualitative research on the drivers and decision-making processes involved in different contexts. Assessment of food environments requires conceptualization of the attributes of food environments, judging how these attributes reflect healthiness, and determining how to construct an assessment method to collect needed data. Creating demand for health diets requires understanding the cognitive and emotional bases of generating intent and desire.

Conclusions: Well-designed research and development of actions to achieve goals for health in preventing an upswing in non-communicable diseases and for mitigating and adapting to climate change is needed. This research and development of actions must be based on solid understanding of food choice, food environments, and demand creation as well as realistic judgment of priorities and what can be achieved working closely with country partners.

Keywords: Food choice, Demand creation, Healthy diets, Low- and middle-income countries

SY(T6)17-02

Advances in methods and metrics in measuring food environments and implications for healthy food choices

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Background and objectives: Given their highly dynamic and informal attributes, food environments in low- and middle-income countries (LMICs) are traditionally difficult to characterise. Further, the concept of food environment encompasses multiple constructs making measurement, to underpin effective policy actions, difficult. The objective of this presentation is to provide an overview of the state-of-the-art developments in methods and metrics to measure and characterise food environments to underpin effective actions for healthy food environments.

Methods: This presentation will include a critical evaluation of food environment methods and metrics and will introduce the latest food environment experience survey tool (FEST), which is currently being piloted in India, Indonesia and Senegal. This tool, developed under the UKRI-GCRF Action Against Stunting Hub, aims to (i) characterise the extent to which nutrient-dense foods are available and affordable within different food environments, and (ii) explore the relative importance of external and personal food environment domains on household food choices.

Results: Existing measures have trade-offs between contextual understanding and scale. Food-system interventions to improve diet quality require actionable data about food environments that is sensitive to context, can be collected at scale, and adaptable for specific foods and food groups of interest. Cognitive testing of FEST highlighted variable levels of understanding around food environment constructs and prompted the adoption of additional contextual information. The results of pilot testing will be available by June 2022 and the presentation will include the results of pilot testing in all three countries and our approach to FEST metric development.

Conclusions: Rapid advancements in developing, testing, and establishing cross-contextual equivalence of food environment metrics are critically needed to underpin effective policy actions. While geospatial tools and observational surveys have gained prominence, promising methods (quantitative and mixed-methods) and metrics to assess how people experience food environments and which constructs of food environments are important for food choices in diverse contexts are rapidly emerging.

Keywords: Food enviroment, Methods, Metrics

Conflict of Interest Disclosure: None

Further Collaborators: Sukarni, R. Southeast Asian Ministers of Education Organization Regional Center for Food and Nutrition (co-author); Chris Turner. Natural Resource Institute, University of Greenwich (co-author); UKRI-GCRF Action Against Stunting Hub

SY(T6)17-03

Changing drivers of food choice in relation to changing food environments

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Background and objectives: People are central to any food system, and how they interact with food environments has broad implications for human and planetary health. Dramatic changes in daily life of people in low-and middle-income countries (LMICs), including changes in how people make a living, drives changes in food choice behavior. The objective of this presentation is to provide a conceptual overview of the pathways of food choice behavior in the context of changing livelihoods that can be used to guide food environment interventions.

Methods: Recent developments in thinking and empirical research about food choice behavior, livelihood change, and food environments in LMIC were reviewed.

Results: Livelihood changes in LMIC that impact food choice behaviors include shifts to wage-based work as people migrate to urban areas, changes in the type and environment of work (e.g., rise in sedentary, technical jobs), and women in the workforce. Income, time use, social interactions, and physical location alterations that come with livelihood change have occurred in tandem with changes in food environments primarily through land use and food choice behavior. Food choice involves the processes by which people produce, acquire, prepare, distribute, and consume foods. Examples of pathways between livelihood changes and food choice are less food produced for household consumption with more market-oriented livelihoods; acquisition of higher cost convenience foods with increased income and further work distance; preparation of processed foods when longer work hours; alterations in intra-household food distribution to accommodate varied work schedules; and consumption of food prepared away from home with increased access during commutes. Livelihoods changes shift social norms, values, and preferences for both healthy and unhealthy foods.

Conclusion: Results highlight the importance of addressing the intersection of food environments and food choice from a dynamic perspective that considers rapid social and environmental changes in the context of history. Understanding the patterning of daily life as determined by livelihood strategies provides insight into pathways between macro-level forces and food choice behaviors that have implications for human and planetary health. Such insight is necessary for contextually grounded and practicable policies and interventions.

Keywords: food choice, food environments, livelihood change, food systems

SY(T6)17-04

A model for creating demand for nutritious diets and foods in Low- and Middle-Income Countries (LMICs)

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Background: 'Demand' as a concept is underconceptualized in public health nutrition but is a well-known concept in business and economics. Demand can be broadly understood as what consumer want or desire and is manifested through usage or purchase. There is increasing agreement in LMICs that to address micronutrient malnutrition and the growing obesity burden, countries need to invest in creating demand for healthy diets. Methods: We conceptualized demand around 'desire' and 'influencing choice'. We focused on lower-middle income parents in Nairobi, Kenya on the assumption that these families have some purchasing power. Drawing from Kok et al. 2011 framework, we applied a 3-phase process: (1) to identify cognitive, emotional, situational determinants affecting desire for nutritious diets, (2) ability of an intervention to change the determinant(s), and (3) programmatic applications. The first phase drew from parenting identity literature and our ethnographic research on parenting and food practices. The second phase consisted of identifying an insight and research to confirm its validity. The third phase was translating the insight into communication materials (radio, TV), to deliver the emotional benefit and drive intentions. Results: Our research found cognitive and emotional dissonance among parents. A peaceful meal was the immediate goal but giving in to children's preferences brought negative parental feelings. The insight that solved the tension among preferences, emotions, and values was: *It is a relief to realise that I am not the only one [parent] struggling. It restores my desire to persevere. To be the parent I want to be. To nourish my family.* The advertising agency converted the insight to the 'Together We Step Up to the Plate' campaign and the FitFood Brand. Conclusion: The research and development culminated in an evidence-based marketing strategy. It was necessary to draw on several disciplines, theories and multiple rounds of research to develop a programme to re-activate parents' innate desire for healthy diets and support their good intentions. The next steps are to deploy the FitFood Brand and campaign and track purchase of vegetables in Nairobi.

Keywords: Demand, Parents, Kenya, Marketing strategy, Food Choice

Conflict of Interest Disclosure: None

Further Collaborators: Quantum Consumer Solutions - ethnographic research; University of South Carolina - parenting identity and analysis; ScanAd - Advertising Campaign ; Kantar Research Services - consumer testing

SY(T6)18-01

A strategy for further wellness for all: population approach to prevent cardiovascular diseases in Japan

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The population approach may be effective in reducing cardiovascular disease (CV) in the entire population. In Japan, the first public population approach is Health Japan 21 from 2000 to 2012. In 2013, it was revised as Health Japan 21 (the second term) that was promoting the health of all citizens until 2022. Concerning CVDs, high blood pressure, dyslipidemia, diabetes, smoking is set as the main risk factor, of which target was 1) a 4 mmHg decrease in mean systolic blood pressure (SBP), 2) a 25% reduction in prevalence of hypercholesterolemia, i.e., total cholesterol (TC) level being 240 mg/dl and greater, or LDL cholesterol (LDLC) being 160 mg/dl or greater, 3) prevention of increase in prevalence of diabetes, 4) decrease in smoking rate (19.5% to 12%). Especially, regarding blood pressure, the target value of nutrition and diet (salt intake, vegetable and fruit intake, i.e., potassium intake, and proportion of over-weight), physical activity, alcohol drinking, and increase of antihypertensive medicine users in hypertensive patients were placed as the first step of the three-layer structure; and from there, a target value of a 4 mmHg decrease in SBP was set as a second-layer target goal. In the final assessment recently performed, although a significant decrease in age-adjusted CVD mortality is observed, it is unclear why these findings occurred. In the future, multifaceted efforts are needed for decrease in blood pressure level, including not only salt reduction, but also evaluation using sodium/potassium ratios, food ingredient labelling and development of foods with enhanced functions. In addition, blood pressure can be easily measured at home, and it is considered effective to strengthen self-monitoring by promoting home blood pressure measurement and linking it to personal health records. With regard to dyslipidemia, because method of health promotion differs between triglyceride and HDL cholesterol, which are lipids related to the metabolic syndrome (closely related to obesity and diabetes), and LDLC, which is weakly related to metabolic syndrome but strongly related to quality of fatty acid. Therefore, it is necessary to promote awareness-raising projects. Furthermore, it is essential to urgently establish an incidence registry system for CVDs to assess the effect of prevention program.

Keywords: population approach, cardiovascular disease, Health Japan 21, mortality, registry system

SY(T6)18-02

Population level approaches to improve diet quality and reduce cardiovascular disease risk in the U.S.

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Poor diet quality is a leading risk factor for cardiovascular disease (CVD) in the United States. At a population level, small incremental improvements in diet quality improve CVD risk factor burden and lower risk of incident CVD. However, at the individual level, sustained dietary change is challenging. Therefore, intervention at the government (policy), food system and community level is needed to affect population level dietary intake. In this presentation, recent evidence for population-based approaches to improve diet quality will be reviewed. Specifically, food product labeling reform, economic incentives, school and workplace initiatives as well as strategies to address nutrition security will be discussed. Social and environmental factors are key determinants of dietary intake and therefore addressing barriers to intake of a healthy diet at these levels is critical to improving population-wide diet quality.

Keywords: Nutrition, Cardiovascular disease, Dyslipidemia, Hypertension, Diet quality

SY(T6)18-03

Salt Reduction – Experience from the UK

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It is well established that dietary salt intake is the major cause of raised blood pressure, which is the underlying cause of cardiovascular disease (CVD). The World Health Organisation (WHO) has listed salt reduction as one of the 'best-buy' interventions to prevent high blood pressure and CVD. The UK initiated a voluntary salt reduction strategy in early 2000s, led the Food Standards Agency (FSA) and CASH (Consensus Action on Salt and Health), a Non-Governmental Organisation. As 70-80% of the salt in the UK's diet comes from packaged and prepared foods, e.g. bread, breakfast cereals, FSA and CASH developed incrementally lower salt targets for over 85 food categories with a clear timeframe for the food industry to achieve. This strategy was very effective, leading to a reduction in salt content by 20-50% in most foods and a fall in population salt intake from 9.5 g/d in 2003 to 8.1 g/d by 2011, as measured by 24-hour urinary sodium excretion. The reduction in salt intake led to a fall in population blood pressure, and prevented approximately 9000 CVD deaths each year and saved the healthcare service about £1.5 billion in annual costs. As the reductions in salt have been made gradually, the public has not noticed any change in taste and crucially no loss in sales of products for the food industry, a true win-win for industry and public health.

The UK's salt reduction model has now been adopted by many countries. To date, almost 60 countries have set salt reduction targets and about a third of these countries have mandated the targets which are more effective than voluntary targets. In 2021, the WHO published global benchmarks for salt levels in over 60 food categories which provide a guide for countries to set salt targets.

Salt reduction is one of the most cost-effective ways to prevent CVD, which is the leading cause of death and ill-health both in the UK and worldwide. Yet, sustaining salt reduction requires considerable persistence in the face of food industry resistance and the current government's indifference.

Keywords: Salt reduction, targets

SY(T6)18-04

Strategies to reduce salt intake in Japan

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Salt reduction is the most important lifestyle modification, especially in Japanese individuals who still consume a significant amount of salt. The Dietary Reference Intakes for Japanese 2020, issued by the Ministry of Health, Labour and Welfare, propose a salt intake goal of < 7.5 g/day for men and < 6.5 g/day for women. Regarding the goal of salt reduction in hypertensive patients, the hypertension guideline by the Japanese Society of Hypertension 2019 (JSH2019) proposes a goal of < 6 g/day. Although the average salt intake in Japan gradually decreased in the early 2000s, the declining trend has not been seen in recent years, and thus, it seems difficult to achieve these target salt intake levels. To overcome this challenge, the JSH announced the 'JSH Tokyo Declaration' and pledged to create a specific action plan to achieve the target salt intake level of < 6 g/day. The six strategies to achieve the target salt intake level are as follows: (1) educating citizens on the harms of excessive salt intake and the importance of reducing salt intake; (2) recommending the assessment of the salt intake of individuals or populations and proposing adequate methods to reduce salt intake; (3) promoting salt reduction for children as a part of dietary education at school; (4) promoting salt reduction in takeout food, prepared dishes, canteens, and school lunches; (5) encouraging companies to develop and promote low-salt foods; and (6) encouraging the government to take measures to promote salt reduction. The JSH is conducting a project to reduce salt intake in the general population with the support of the Ministry of Health, Labour and Welfare and the Ministry of Economy, Trade and Industry. In particular, estimated 24-hour urinary salt excretion is measured for the participants in specific health checkups, and guidance regarding salt reduction is provided to them. Additionally, efforts to improve the food environment are underway so that local residents can easily obtain information on low-salt foods and access stores for

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

purchasing them. Through these activities, a society with a low salt intake will be expected in the near future.

Keywords: Dietary salt intake, Guidelines, Japanese Society of Hypertension, Population approach

SY(T6)19-01

Food Labeling Systems in Japan -Nutrition and Health Claims-

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Japan is one of the countries with the highest life expectancy in the world. However, there is a gap between life expectancy and healthy life expectancy, that is nearly 9 years in males and 12 years in females. In order to reduce this gap, maintaining good health is important. According to World Health Organization (WHO), self-care is the ability to promote health, prevent disease, maintain health, and so on. Adopting self-care, in other words, practicing healthy life habits including healthy dietary habits would reduce the risks of non-communicable diseases. In Japan, food labeling has been regulated under three laws that were “Food Sanitation Act”, “Health Promotion Act”, and “Act on Japanese Agricultural Standards”. This regulation system was complicated for both consumers and food business operators. To dissolve this problem, “Food Labeling Act” has enacted in 2015. It is stated that food labeling plays a role “to contribute to the protection and promotion of the health of the people” in the Food Labeling Act. Food label is consisted in nutrition claim and health claim with health protect information. Nutrition claim exhibits the contents of energy, protein, fat, carbohydrates, and salt equivalent, which are mandatory, and saturated fat and dietary fiber, which are recommended in Japan. At this time, *trans*-fatty acid is not listed up because of lower amount of consumption among Japanese consumers than WHO recommendation. On the other hand, health claim exhibits health maintenance and health promoting by nutrients/ingredients in foods. Under the Food Labeling Act, foods allowed to label health claims, are specified as “Foods with Health Claims” that include three categories, “Foods with Nutrient Function Claims (FNFC)”, “Foods for Specified Health Uses (FOSHU)”, and “Foods with Function Claims (FFC)”. Consumer Affairs Agency reported that 72% of consumers knew that there was a nutrition label on the packages. Among them, 53.4% checked the fat contents, and 46.7% checked the protein contents. Only 20.4% checked salt equivalent. Nutrition label serves as a parameter for a healthier food choice, but consumers cannot use food label to select low-salt equivalent foods that is the major issue in Japan. In addition, consumers could not understand properties of “Foods with Health Claims”. Some of them could not recognize a distinction between medicines and “Foods with Health Claims”, and use them to treat diseases. In this situation, some consumers experienced adverse events. Food label is a beneficial tool which encourages people to conduct self-care and maintain their health. However, both nutrition claim and health claim are underutilized by consumers. In this regard, front-of pack labels (FOPLs), is a beneficial tool which encourages people to choose healthier foods. However, FOPLs is still unfamiliar in Japan, so we have to investigate which nutrients and which type of FOPLs are the best for Japanese people. In addition to FOPLs promotion, education is important to get consumers using food labels for extension their healthy life expectancy.

Keywords: Food label, Front-of-pack labels, Nutrition, Foods with Health Claims, Healthy life expectancy

SY(T6)19-02

Current Status of Nutrition Labelling and Claims in SEA Region

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Nutrition labels, as well as nutrition and health claims, are important tools to communicate the nutritional quality and health benefits of prepackaged food to consumers. They provide point-of-sale information to help consumers make informed choices to keep themselves healthy. Recognizing this, most regulatory authorities in Southeast Asia have enacted regulations on nutrition labelling and nutrition and health claims. However, there is wide disparity in the regulations on nutrition labelling and claims in the region. The number and types of nutrients to be declared on nutrition information panels (NIP) or Nutrition Facts as well as the format and expression for nutrient declaration are quite different among the countries. In addition, differences in the types of health claims permitted, the criteria for the claims and the regulatory systems related to these claims are also observed. These differences may cause confusion among consumers and are technical barriers to the distribution of commercial prepackaged food products. The ASEAN Committee for Harmonisation of Prepared Foodstuff Standards (ACHPFS), under the Prepared Foodstuff Products Working Group (PFPWG) of ASEAN Consultative Committee on Standards and Quality (ACCSQ), is the main body for making recommendations for the harmonization of priority standards for the prepared foodstuff sector. It is currently facilitating the harmonization of nutrition labelling which includes the development of ASEAN Guidelines on Nutrition Labelling, and harmonization of Nutrient Reference Value (NRV). In this presentation, the regulatory status of the nutrition labelling and various types of health claims permitted in selected SEA countries, including the regulatory framework for application and review of claim applications, as well as the scientific substantiation requirement will be shared.

Keywords: Nutrition Labelling, Nutrition and Health Claims, Current status, Harmonization

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)19-03

Consumer use and understanding of Health Star Rating (HSR) nutrition labels, and the impact of HSR labelling on dietary habits

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Background and objectives: Front-of-pack nutrition labelling (FoPL) of packaged foods aims to promote healthier diets. New Zealand (NZ) and Australia adopted the voluntary Health Star Rating (HSR) scheme in 2014. We aimed to examine the effect of the HSR on population diets via two pathways: consumer food purchasing behaviour and industry reformulation of labelled foods relative to unlabelled foods.

Methods: We undertook three research studies: (1) a randomised controlled trial (n=1357 New Zealand shoppers) of the effects of HSR and traffic light labels versus a control on short-term food purchasing behaviour; (2) fixed effects analyses of Nielsen Homescan household-purchasing panel data to estimate the association of HSR with product and nutrient purchasing over time (2013-2019); and (3) a difference-in-differences analysis of packaged food composition over time (58,905 unique products across 14 major food groups) to estimate product reformulation associated with voluntary HSR adoption.

Results: At the relatively low level of use observed in the randomised controlled trial, neither HSR nor traffic light labels nutrition labels had any significant effect on food purchases. In 2019, 24% of all products in the Nielsen NZ Homescan dataset were labelled with HSR (25% of purchasing volume). Adoption of HSR was selective however with 46% of HSR-labelled products displaying a rating of 4.0-5.0 stars compared with 19% displaying a rating of 0.5-2.0 stars. We found little or no association between HSR labelling and the quantities of different foods purchased by NZ households over time. Introduction of HSR was, however, associated with lower sodium, lower protein, and higher fibre purchases when purchased products displaying an HSR were compared to the same products prior to introduction of the program. **Conclusions:** Robust evidence of HSR labels changing consumer purchasing behaviour was not observed. However, because of industry reformulation of foods in response to the HSR, it was associated with net changes in nutrients purchased: 9% lower sodium, 3% lower protein, and 5% higher fibre. We conclude that FoPL is justified, and should arguably be mandatory, given it alters product composition to be healthier and consumers have a right to clear information on the healthiness of foods.

Keywords: Nutrition labels, Health Star Rating, Effectiveness, Population diets

Conflict of Interest Disclosure: Cliona Ni Mhurchu is a member of the Health Star Rating Advisory Committee. The Committee had no role in study design, data collection and analyses, decision to publish, or preparation of manuscripts and presentations.

SY(T6)20-01

Climate Change and Nutrition

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While much attention has been devoted to how climate change threatens food supplies and food security, there has been less focus on the effects of climate change on human nutrition. In the climate change-nutrition discourse, micronutrients play a core role. The impacts and disruptions associated with climate change—including the rise in atmospheric carbon dioxide, greater land degradation, more extreme weather, and rising sea levels, to name just a few—are jeopardizing people's micronutrient status. In addition, at the same time that climatic shocks and crises threaten individuals' nutrition security, climate change-induced rises in the prevalence of waterborne diseases may increase human micronutrient needs.

Micronutrients are thus key to mitigating the impacts of climate change on human nutrition. Improving micronutrient resilience in the face of climate change will mean promoting context-specific, sustainable, diverse diets through both food production and connections to markets and trade. It will entail advancing large-scale food fortification as well as investing in the development of climate-resilient, more nutritious key crops (biofortification). And, importantly, it will call for ensuring access to micronutrient-rich foods at the heart of social protection systems and humanitarian activities.

Keywords: Climate change, nutrition security, micronutrients

SY(T6)20-02

The Role of Micronutrients on Immune Function

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Nutrition is a determining factor of an adequate immunologic response. Protein and energy undernutrition impacts all immune-related functions. However, even in the face of adequate macronutrient supply, micronutrients in general, and some vitamins and minerals specifically, can significantly affect the protective and recovery immune mechanisms necessary for prevention and recovery from infectious disease. The dependence on nutrition for an adequate immune response is accentuated both in early life and in the elderly, and in those with underlying conditions associated with increased demands, higher nutrient losses, or inadequate metabolism. In situations with underlying poor micronutrient intakes, the effect is compounded by increased requirements in the face of infection, stress, and pollution. Poor micronutrient status, in general, is a

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

risk factor for an increased rate of infections, poor outcomes, and increased mortality. The recent COVID pandemic is an instance where the adverse impact of inadequate nutrition on the immune system, including its inflammatory components, may explain the higher risk of severe outcomes and mortality from viral infections like SARS CoV2 in the elderly, as well as those with obesity, including obese children. Specific micronutrients, namely vitamins A, D, C, E, B6, and B12, folate, zinc, iron, copper, and selenium, play key roles - individually and synergistically - in all phases of the immune response. Individual and combined deficiencies will reduce immune competence and/or disrupt systemic inflammatory regulation. Whether part of the innate or adaptive immune response, in varying degrees, these micronutrients are central to the integrity of physical and chemical barriers and immune cell function. Their roles are broad and interconnected, including supporting integrity of mucosal, skin, and epithelial surfaces, differentiation, proliferation, functioning, and movement of innate immune cells, defensive cytotoxic leukocyte function, antibody secretion, and modulation of pro- and anti-inflammatory cytokines. Thus, individual and combined deficiencies increase vulnerability to infections in general. Although the data is inconsistent, some evidence suggests that supplementation with some micronutrients, particularly vitamins C and D, and zinc, in some circumstances can help reduce the risk of infection. Or, they can serve as therapeutic adjuvants, attenuating infection symptoms and severity, and accelerating recovery, especially in viral respiratory infections, including influenza and possibly SARS CoV2. However, nutrient supplementation during active infections should be treated cautiously and should avoid exceeding safe limits. Finally, malnutrition in general, and micronutrient deficiencies in particular, are likely to play a role in the quality of a protective response to various vaccines. While the data is limited, such responses can be elicited, albeit with lower protection levels than those who are adequately nourished.

Keywords: Nutrition, Immunity, Micronutrients, Infection, Malnutrition

SY(T6)20-03

Learning in crisis: gathering recent [data and] evidence to inform resilient micronutrient policies

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1. Johns Hopkins Bloomberg School of Public Health (USA)

Almost three years into the pandemic, actual data on nutritional status are emerging unevenly. Few countries have anthropometric data, and accurate infant and child mortality data from LMICs are limited. However, there are evidence for a dramatic increase in food insecurity and disturbing declines in dietary diversity for households and children. Governments responded to the crisis with an unprecedented range of policies, including adaptations to continue to deliver nutrition and nutrition-sensitive programs, and the initiation of expanded or new social protection programs to build resilience among the most vulnerable households. An analysis of these programs by sector, with a gender lens, will illustrate examples of nutritional resilience capacities (absorptive, adaptive, and transformative capabilities). Importantly, it will also identify data and knowledge gaps that are limiting our ability to advance resilient policies and programs across sectors.

The world is now experiencing a 'crisis on crisis' with severe climate events, conflict and the global food crisis – perhaps a 'new normal'. As a nutrition community, we must work together to identify and analyze evidence to provide policy guidance to promote nutrition resilience. Policy-makers and funders must bridge the gap between humanitarian and development responses to facilitate nutrition resilience.

SY(T6)20-04

Nutrition & Resilience: Program Challenges, Research Gaps and Opportunities

Patrick Webb[1]

1. Tufts University (USA)

The 2020s have so far exposed the stark fragility of our global and local food systems in dramatic, previously unexpected ways. The shocking impacts of climate change were compounded by the Covid pandemic, and then amplified by the Ukraine crisis. Once again, food price hikes, supply chain bottlenecks, and concerns about reliance on international trade have all focused the minds of policymakers and business investors on the hurdles involved in making sustainable healthy diets available and affordable to all. This presentation will discuss the dynamic nature of these challenges and policy reactions to such unstable processes. It will also explore implications for nutrition and health from both programmatic and research perspectives. Will the world revert to self-sufficiency goals and technocratic approaches to securing supplies of low cost calories? Or will this moment in time be seized to achieve transformational change?

Keywords: Nutrition, Resilience, Affordability, Diets, Sustainability

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)20-05

Impact of rising global food prices on vulnerable populations

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More than one-quarter of the world population cannot afford a sufficient, healthy, and nutrient-adequate diet. The poorest ones, around 800 million, suffer from insufficient access to staple foods and calories. Beyond calories, more than 2 billion people suffer from micronutrient malnutrition due to insufficient intakes of higher-value, nutritious foods. Women and children are often particularly affected by malnutrition with long-term negative health consequences, including weakened immune systems, physical and mental development problems, and premature deaths.

Reducing malnutrition and improving dietary quality will require higher incomes among poor and vulnerable population groups. Hence, pro-poor income growth must be an integral part of any longer-term strategy to fight undernutrition. At the same time, downside income shocks among the poor must be avoided or cushioned to the extent possible, as income losses exacerbate dietary quality.

Beyond income, food prices determine the affordability of healthy diets. Poor people have to spend a large fraction of their income on food anyway, so that low food prices are conducive whereas rising food prices make it harder to afford diets that are sufficient in quantitative and qualitative terms. When food prices rise, poor people tend to reduce the consumption of higher-value, nutritious foods first, as these are more expensive sources of calories needed to fill the stomach. However, higher-value foods such as fruits, vegetables, and animal-sourced products are rich sources of micronutrients, so that their reduced consumption exacerbates micronutrient deficiencies. If changes in the types of foods consumed are not enough to cope with food price rises, the consumption of staple foods is also reduced, leading to additional calorie and nutrient deficiencies. Even temporary nutritional deficiencies during early childhood are often associated with irreversible development impairments.

Over the last two years, the COVID-19 pandemic has contributed to widespread job and income losses in the global south. At the same time, global food prices have been rising due to high energy prices, high transportation costs, high fertilizer prices, supply chain disruptions, and weather-related harvest failures in some major food-producing regions. The Russian attack on the Ukraine has further increased food prices dramatically, as both Russia and the Ukraine are major exporters of cereals and oilseeds, so reduced exports during the war are associated with food shortages in many other parts of the world as well. In the first half of 2022, global food prices were higher than ever before during the last 60 years. This is extremely worrisome and threatens to reverse recent nutritional improvements especially in Africa and Asia.

The world must act to avoid further nutritional crises. First, better social protection measures need to be put in place in order to cushion poor and vulnerable population groups. Second, sustainable productivity and efficiency growth in food production and distribution are needed to increase the stability and affordability of diverse and healthy food supplies. Third, more sustainable consumption styles need to be promoted to reduce food waste and inefficient resource use.

Keywords: Food prices, Income shocks, Hunger, Micronutrient malnutrition

SY(T6)20-06

Micronutrient Deficiencies and Resilience in Asia

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1. Institute of Nutrition, Mahidol University (Thailand)

The remarks will focus on policy-enabling environments for micronutrient resilience including ways to integrate nutrition and micronutrients into food systems transformation and will highlight pro-micronutrient policies undertaken across South and Southeast Asia.

Today, South Asia, and Southeast Asia countries disproportionately suffer from the impact of global climate crisis particularly relating to decreased yields of micronutrient-rich foods and fisheries catch. Communities across the region are mitigating and adapting to the impacts through various nutrition sensitive policies and actions.

In Bangladesh, a policy focus to improve the bioavailability of micronutrient-rich foods and high-quality protein was included in the Third Country Investment Plan for Sustainable, Nutrition-Sensitive, and Resilient Food Systems. The Plan focuses on dietary diversity food safety, food loss and waste, gender sensitivity, and resilience to the effects of climate change.

The 1995–2000 National Plan of Action for Nutrition of Vietnam promoted traditional farming system. This resulted in higher household incomes and greater production of micronutrient-rich foods (meat, fish) and rice; and improved dietary intake and reduced the prevalence of anemia and vitamin A deficiency.

Thailand's reduction in hunger and undernutrition indicators was achieved through community-based nutrition programs. Local production of vegetables, fruits, rice, fish, and chicken; supplementary food for pregnant mothers; complementary food for infants and young children; food preservation and processing; and cooperatives and microcredit have improved the nutrition security of the population.

Nepal recovery after a severe earthquake in 2015, reduced child wasting, child stunting, and household food insecurity involved interventions focused on childhood nutrition.

A clear lesson is that merging micronutrient and resilience agendas requires the alignment of local and national policies; the coordination of human and material resources; and strengthening local food production to support for climate-resilient dietary diversity.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)20-07

Transforming food systems to nourish and build resilience

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Under existing food systems, about 3 billion people cannot afford a healthy diet and malnutrition in all its forms is the largest preventable burden of disease for individual countries and globally. This includes widespread micronutirent deficienies. In addition, it is estimated that current food systems account for 25% of all greenhouse gas emissions and 70% of biodiversity loss. Adequate nutrition for resilience, a desired outcome from food systems that provide the required nutrients across the life cycle, from conception to old age, is not accessible to many. Healthy and sustainable diets should be at the heart of providing the needed nutrients. But current food systems present multiple challenges resulting in inadequate diets that fail to nourish populations optimally for both rich and low- and middle-income countries (LMICs). For LMICs food insecurity, low production diversity, non-affordability of healthy nutritious diets and conflict, are significant challenges, further compromised by increasing environmental degradation and climate change that threaten present and future food security. For rich countries, unsustainable production and consumption practices and environmental degradation present, nutrition and health risks and negative environmental impacts threaten future food security. All settings would benefit from appropriate food systems transformation that can make healthy nutritious diets from more sustainable food systems accessible to the majority while mitigating against climate change and improving resilience. Given the enormity of the challenges faced the United Nations Food Systems Summit 2021 (UNFSS-2021) was convened to promote accelerated progress on the needed food systems transformation - led by UN member countries. Majority of the UN member states responded to this call. However, significant challenges need to be addressed for the magnitude of transformation needed to be realized. This symposium presentation will address the existing challenges, recommending that transformation to food systems that nourish and build resilience calls for a nuanced approach under different settings.

Keywords: food systems, nutrition, transformation, resilience

SY(T6)21-01

Symposium Overview: Building momentum for the rights of children to healthy diets and a sustainable future

Kjørven Olav[1]

1. EAT (USA)

The presentation will provide an overview of why improving children's access to healthy and sustainable diets needs to be prioritized as an integral part of a larger strategy towards food systems transformation. It will present EAT's work in this area, particularly through the Children Eating Well (CHEW) collaboration with UNICEF and other partners; our work as lead of Action Track 2 (Shifting to Sustainable Consumption Patterns) of the UN Food Systems Summit held in 2021; and, continuing on from that work, the building of the Coalition for Healthy Diets from Sustainable Food Systems for Children and All (HDSFS) and the School Meals Coalition. The presentation will draw attention to the framework for action that was developed by CHEW and, in important ways, adopted by UNICEF, and will show how this work has informed EAT's engagement towards the UN Food Systems Summit and its contributions to the creation of HDSFS. Finally, the presentation will draw attention towards priority issues, challenges, and opportunities when it comes to making real progress in improving nutritional outcomes for children in such a way that the rights, needs, and voices of children today and in the future are front and center—including when it comes to ensuring that they can inherit a healthy planet.

Keywords: Children, health, nutrition, sustainability, coalition

SY(T6)21-02

Priorities for Action: What do the framework and evidence say about how to transform food systems to provide healthy diets for children?

James Garrett[1]

1. Alliance of Bioversity and CIAT / CGIAR (Italy)

The presentation will review the CHEW framework and current evidence in greater depth, using a systems lens, noting impact pathways, connections among framework elements, key entry and leverage points, and priority areas of action for policies and programs. The presentation will also relate the framework and areas for action to current evidence and experiences and note critical knowledge gaps. It will also note key principles and challenges undergirding the transformation of agri-food systems to provide healthy and sustainable diets for children.

Keywords: Food system transformation, children, diets

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)21-03

After the UN Food System Summit: The Coalition of Action on Healthy Diets from Sustainable Food Systems for Children and All (HDSFS) takes off

Stineke Oenema[1]

1. UN Nutrition (Italy)

The presentation will highlight the creation, membership, governance, and activities of the Coalition of Action on Healthy Diets from Sustainable Food Systems for Children and All (HDFSF), which was formed following the UN Food System Summit in 2021 and can serve as a leading platform to support global and country efforts to achieve healthy diets for children. The Coalition membership includes governments as well as global NGOs, research organizations, and development agencies. Its secretariat is administered by WHO, FAO, and UN Nutrition. The Coalition has established principles of engagement and was officially launched in May 2022. It has three core functions: mobilize relevant expertise, especially in partner countries themselves; facilitate peer-to-peer learning; and manage special projects. Already, several learning events have taken place and a number of frontrunner countries have joined from all over the world. Currently the Coalition has two special projects underway: promotion of food-based dietary guidelines that include sustainability criteria; and the inclusion of food and nutrition in Nationally Determined Contributions (NDCs). For the coming year another project will take off, focusing on healthy diets in fragile contexts.

Keywords: Healthy diets, sustainability, food systems

SY(T6)21-04

Creating Sustainable Agri-Food Systems that Provide Healthy Diets for Children: Ghana's experiences

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1. University of Health and Allied Sciences (Ghana)

In sub-Saharan Africa, the food and nutrition security situation is dire and portends serious consequences for public health and sustainable development. The rate at which non-communicable diseases (NCDs) are increasing in sub-Saharan Africa (SSA) is alarming. By 2030, NCDs are predicted to become the leading cause of death in Africa. Incorporating healthy eating into the diets of children is important for ensuring a healthy life for them, including helping to prevent NCDs and other diet-related diseases later in life. In Ghana's current situation the high costs of food, especially fruits and vegetables and animal-source foods, which constitute important aspects of healthy diets, make it difficult for most people to afford healthy diets. It is important to put children at the center of the needed food systems transformation. Early initiation and education of children with respect to healthy diets and healthy eating will ensure these become an integral part of their lifestyle. Ensuring children eat healthy diets will have a lifelong impact on their health, nutrition, and overall well-being and also, over the course of their lives, have a positive impact on the shape and sustainability of the food system itself. Most children these days are used to the consumption of sugar-sweetened beverages, which pre-exposes them to various kinds of NCDs, malnutrition, and other nutrition-related diseases. One of Ghana's efforts toward achieving sustainable food systems and providing healthy diets for children is increasing awareness among communities and policymakers of these issues and of the policies and tools they can use to promote healthy diets for children. For example, greater involvement of community members will enable community ownership and an increased sense of responsibility toward transforming food systems to be sustainable and ensure healthy eating among children. Tools such as food-based dietary guidelines can direct and influence the dietary habits of individuals and provide nutritional recommendations for various age groups, including children. Currently, Ghana does not have active food-based dietary guidelines and therefore finds it difficult to alter the dietary behaviors of individuals. Ghana should also intensify nutrition education in the school curricula at all levels (from kindergarten through tertiary level), making sure children have the knowledge to eat healthy diets but also recognizing their roles as change agents.

Keywords: nutrition and food security, food-based dietary guidelines, non-communicable diseases, food systems, healthy diets

SY(T6)21-05

Transforming Food Systems to Provide Healthy Diets for Children: Insights on 'what' and 'how' from country experiences

James Garrett[1]

1. Alliance of Bioversity and CIAT (Italy)

Drawing on country experiences in Africa, Europe, and Latin America, the presentation will focus on what countries are doing to shape food systems to provide healthy diets for children and the lessons learned from those experiences. As with food system transformation generally, food system transformation focused on benefiting children can engage elements of production, transportation, storage, food safety, processing, marketing and the food environment, and consumer knowledge and consumer choices. But what does it mean to shape the food system *for children*? How does this differ from more general "food system transformation"? What have countries decided are their priority actions in terms of policies, programs, and "targets for change"

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

to promote healthy diets for children, and why? What are their strategies, their steps to transformation, and how do they envision engaging the system as a whole? What institutions, platforms, and institutional and program settings do they use, and why? What are some of the challenges they have encountered in their initiatives – say, in terms of political interest, bringing key actors together, program design and implementation, or just getting started using this perspective? And how do they deal with these challenges? What are the key lessons they want to highlight for others wanting to do similar work?

Keywords: policies, programs, children, healthy diets

SY(T6)22-01

Advancing methods and tools to assess and monitor healthy diets

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1. University of South Carolina (USA)

Unhealthy diets are responsible for one in five deaths worldwide. Households and individuals, to achieve good nutrition and health, must consistently access and consume a healthy diet that provides optimal amounts of nutrients and other dietary constituents (e.g., dietary fiber) required for good health.

Routine dietary assessment and monitoring of the healthfulness of dietary intake is needed at global and national levels to support policies and programs that promote healthy diets and evaluate their effectiveness. Few countries assess and monitor diets, in part because of the lack of harmonized methods, tools, measures, indicators, and data platforms to do so.

Knowing what to assess and monitor means knowing what are the sub-constructs that make up the construct of healthy diets. Furthermore, methods and tools are needed that yield measures and indicators that reflect the sub-constructs of healthy diets and are valid and cross-context equivalent. Finally, data platforms must be available that can accommodate the methods and tools to collect the needed data.

In May 2021, WHO-UNICEF Technical Expert Advisory Group on Nutrition Monitoring and the Food and Agriculture Organization of the United Nations, with technical and logistical support from US Agency for International Development Advancing Nutrition, organized a technical consultation to catalyze progress toward identifying a parsimonious set of methods and tools for global assessment and monitoring of healthy diets. Eighty-five experts engaged in the consultation, representing a wide range of institutions, geographic areas, and roles in the data value chain. Building on the outputs of the 2021 Technical Consultation, work is being undertaken in 2022 to 1) identify, and reach consensus on, the sub-constructs of a healthy diet that should be measured, 2) scientifically assess the validity, usefulness, and fitness-for-purpose of existing healthy diet methods and tools, and 3) identify gaps in knowledge and in the existing methods and tools that will require additional research. This work will contribute to guiding governments and others seeking to assess and monitor healthy diets and provide the basis for selecting one or more assessment methods for global and country dietary assessment and monitoring through the next set of Sustainable Development Goals.

Keywords: diets, measures, indicators, tools, validity

SY(T6)22-02

Food environment assessments in low- and middle-income country settings: an overview of their use and application for informing healthy diets

Shauna Downs[1]

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Food environments are rapidly changing in low- and middle-income countries (LMICs), contributing to poor quality diets as well as a growing burden of obesity and diet-related non-communicable diseases. While many food environment assessments have been developed for use in high-income countries, few have been designed, or adapted for, LMIC contexts. Given the dynamic and informal nature of these food environments, assessments that are designed to capture the dimensions (i.e., availability, affordability, promotion and quality, convenience) of these environments in a practical way are needed. This presentation will provide examples of food environment assessments that have been piloted in LMICs to date and provide insight into their strengths and weaknesses. It will also identify areas for future research aimed at filling existing gaps in food environment assessments in LMICs. By improving our ability to measure the different dimensions of food environments in diverse settings it will enable researchers and practitioners to better identify the ways in which food environments can be leveraged to support healthy diets.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T6)22-03

Understanding diets and micronutrient adequacy at sub-national scales using Household Consumption and Expenditure Survey tools

Kevin Tang[1]

1. London School of Hygiene and Tropical Medicine (UK)

Addressing diets that are inadequate to meet micronutrient needs across LMICs is challenging as they require detailed sub-national assessment to evaluate whether populations with the greatest risks for micronutrient deficiencies are being adequately reached within a country. Dietary data collected via Household Consumption & Expenditure Surveys (HCES) contribute key insights into the quality of diets and can be used to model the potential for micronutrient interventions to help meet the micronutrient needs of at-risk populations. Integrated within nationally representative household surveys, this style of dietary data quantifies foods reportedly consumed by households through a recall using a standard list of commonly consumed food items. When combined with food composition data, these dietary data can generate metrics to provide insights into whether households' dietary micronutrient supplies are sufficient to meet micronutrient requirements. Additionally, adjustments to the composition of key food vehicles can model the potential micronutrient contributions from micronutrient interventions. HCES-based modeling estimates contribute valuable sub-national insights that can characterize dietary quality, coverage of food vehicles, and the potential for filling nutrient gaps. The use of HCES data to contribute to data-driven nutrition decision-making is being facilitated by the development of open-source nutritional assessment tools aimed at making HCES data more widely accessible to inform policies and programs to improve diet quality.

Keywords: household consumption and expenditure surveys, healthy diets, micronutrients, vitamins and minerals

SY(T6)22-04

Methodology to Assess Needs and Use Data to Design Large-Scale Food Fortification Programs to Improve Diets

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Objective: Large-scale food fortification (LSFF)—the addition of vitamins and minerals while processing commonly consumed staple foods and condiments—is a cost-effective strategy when designed and implemented appropriately. LSFF can deliver nutrients to improve micronutrient intakes without changes in dietary habits or food delivery systems. However, barriers at various stages prevent LSFF from reaching its full potential, including access to and effective use of data to inform the choice of food vehicles and fortification formulation. USAID and USAID Advancing Nutrition developed a methodology using existing data to assess food consumption and micronutrient intake to determine potential fortifiable food vehicles for micronutrients found to be insufficient in the diet. The methodology aims to model the potential contribution of fortifiable foods to micronutrient adequacy and reducing the cost of an adequate diet. It is designed to be a feasible and cost-efficient methodology to guide programming and policy actions.

Methods: We first conducted a literature review to design the methodology. We are piloting the methodology in Zambia using existing data from the 2013/2014 Zambia Food Consumption and Micronutrient Status Survey, along with data from the 2015 Zambia Living Conditions Monitoring Survey. To estimate micronutrient adequacy of the diet, we will use the estimated average requirement (EAR) cut-point method for all micronutrients except iron, for which we will use the full probability approach. We will use harmonized average requirements (H-ARs) to determine adequacy levels. We will estimate consumption of centrally processed fortifiable foods in grams per adult female equivalent per day. We will then use these data to model the potential contribution of food fortification to micronutrient adequacy and the cost of an adequate diet for different strata of the population using various feasible food fortification formulations. We will use the Save the Children Cost of the Diet tool to model diet cost.

Findings: We will share the preliminary findings from our analyses, including the prevalence of inadequate micronutrient intake among different strata of the population and modeling the potential contribution of centrally processed fortifiable foods to micronutrient intake. We will also share the cost of an adequate diet with and without the contributions from fortifiable foods, and with various feasible food fortification formulations.

Conclusions: We will share the conclusions from our preliminary findings and recommendations regarding using the methodology to assess micronutrient needs and design LSFF programs to address the needs, as well as implications for use with other programs that aim to improve diets.

Keywords: food fortification, methods, assessment, design

SY(T6)22-05

The Diet Quality Questionnaire (DQQ): Development, validation, and application as a 5-minute data collection tool for dietary diversity and other diet quality indicators

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Poor diets are a cause of malnutrition in all its forms, including undernutrition and diet-related non-communicable diseases (NCDs). As one of the largest public health risk factors in the world, diet has been one of the most poorly tracked. Until recently, basic and current data about what people eat has been difficult to collect, and has never been collected comparably across countries globally. Quantitative dietary intake surveys are costly and require a high input of time and expertise to carry out, and therefore are rarely done at national scale. The Diet Quality Questionnaire (DQQ) was developed to fill the gap in scalable data collection tools for monitoring and nutrition surveillance: it is a low-burden, low-cost survey module designed to capture the data needed for validated indicators of diet quality. It is a set of yes/no questions about the consumption of food items that represent 29 food groups, including food groups including healthy foods and foods to limit. The food groups are universal, while the questions have been rigorously adapted to each country. Each country-adapted DQQ is read aloud by survey enumerators, taking approximately 5 minutes and minimal training. Country-adapted DQQs are available for over 100 countries as a global public good at dietquality.org. These can be used to gather standardized data on diet quality indicators including the minimum dietary diversity score for women (MDD-W), consumption of food groups recommended in food-based dietary guidelines, and the Global Dietary Recommendations score as an indicator of adherence to WHO recommendations and dietary risk factors for NCDs. Companion DQQs adapted for infants and young children (IYC) are also available for monitoring WHO and UNICEF indicators of IYC feeding. The DQQ was implemented in nationally representative surveys carried out by the Gallup World Poll in 40 countries in 2021, and the questions are also being used in the core module of DHS. This presentation will provide an overview of DQQ design, validation, and demonstration of the indicators derived from DQQ data.

Keywords: nutrition surveillance, monitoring, MDD-W, accountability, Global Diet Quality Project

Conflict of Interest Disclosure: none

Further Collaborators: Global Diet Quality Project

SY(T7)1-01

Potential role of multifunctional food protein-derived peptides in human health

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Food protein-derived peptides have gained increasing attention as potential therapeutic tools for the management of various human diseases. One of the unique features of these peptides is their ability to modulate various metabolic reactions involved in the pathogenesis of chronic diseases. Peptides with simultaneous effects on more than one metabolic reaction are termed multifunctional and represent a new generation of therapeutic tools that could enable the use of a single compound or product for effective prevention and treatment of multiple diseases. In this presentation, novel multifunctional peptides derived from the enzymatic hydrolysis of pea proteins are presented. To obtain these peptides, pea protein isolate was hydrolyzed with alcalase, chymotrypsin, pepsin or trypsin followed by membrane ultrafiltration separation of the hydrolysate peptides into < 1, 1-3, 3-5, and 5-10 kDa fractions. Alcalase was the most effective catalyst in producing low-molecular weight peptides that were dominated mainly by di- and tripeptides. In contrast, pepsin, chymotrypsin, and trypsin produced longer chain peptides. The protein hydrolysates and peptide fractions were tested as inhibitors of α-amylase, α-glucosidase, pancreatic lipase, trypsin and chymotrypsin. Results indicated stronger inhibition ($p < 0.05$) of α-amylase through competitive binding to the enzyme active site when compared to α-glucosidase, which was inhibited non-competitively. Membrane ultrafiltration fractionation led to reduced inhibition of lipase activity and the unfractionated hydrolysates were more effective than the peptide fractions. In contrast, the fractionated peptides had stronger inhibition ($p < 0.05$) of trypsin activity with mean IC_{50} of 2.2 mg/mL when compared to 6.8 mg/mL for the unfractionated hydrolysate. Similarly, peptide inhibition of chymotrypsin activity was significantly ($p < 0.05$) enhanced by ultrafiltration, especially peptide sizes > 3 kDa. Kinetics of enzyme inhibition indicated that the peptides inhibited trypsin and chymotrypsin activities through competitive mode, which reduced substrate access to the enzyme active site. It can be concluded that the pea protein hydrolysates and peptide fractions have potential uses as agents against obesity and diabetes as a result of their effective inhibitions of α-amylase, α-glucosidase, and pancreatic lipase. The same peptides could also serve as protease inhibitors against trypsin and chymotrypsin activities with potential uses in the prevention or treatment of virus infections and cancer.

Keywords: Protein hydrolyates, Bioactive peptides, Multifunctional activity, Yellow field pea, Enzyme inhibition kinetics

SY(T7)1-02

The potential use of a food-derived peptide IRW against osteoporosis

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Osteoporosis, due to an imbalance between bone formation (osteoblastic activity) and resorption (osteoclastic activity), affects millions of people worldwide. Most current pharmacological therapies are targeting to inhibit osteoclastic activity, which are associated with side effects and are limited in their ability in restoring new bones. IRW (Ile-Arg-Trp), a tripeptide derived from egg white ovotransferrin, was previously shown to exert various biological activates in cells and in animals. In our recent work, we have shown that IRW inhibits osteoclastogenesis and promotes osteogenesis in the mouse macrophage RAW 264.7 and MC3T3-E1 cells. IRW (25 and 50 μM) significantly inhibited the osteoclastogenesis-associated factors [TRAF6 (TNF Receptor Associated Factor 6), c-fius protein (c-Fos), Nuclear Factor of Activated T Cells 1 (NFATc1), and cathepsin K] and upregulated osteogenesis-associated factors [RUNX2 (Runt-related transcription factor 2) and RANKL (Receptor activator of nuclear factor kappa-B ligand)] in the two cell lines. Using ovariectomized (OVX) Sprague-Dawley rats, which mimic to postmenopausal osteoporosis due to a lack of estrogen. Oral administration of IRW did not affect body weight, food intake and organ weight, indicating a lack of toxicity of IRW. After 12-week treatment, feeding IRW at a dose of 45 mg/kg body weight prevented OVX-induced bone loss and maintained relatively high bone mineral density and integrated bone microarchitecture. The serum concentration of biomarkers indicating bone formation was increased in IRW treated groups, while the bone resorption biomarkers were decreased. Our research supports a potential use of a food-derived peptide against osteoporosis.

Keywords: bioactive peptide IRW, Osteoporosis

SY(T7)1-03

Cholesterol-lowering food peptides

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1] IIAEK

IIAEK (Ile-Ile-Ala-Glu-Lys, lactostatin) is a novel cholesterol-lowering pentapeptide derived from bovine milk β-lactoglobulin. We identified the target protein interacting with IIAEK and evaluated whether IIAEK specifically interacted with the target protein to improve cholesterol metabolism. We tested the effect of IIAEK on intestinal cholesterol metabolism using Caco-2 cells. We used photoaffinity labeling and nano LC-MS/MS analyses using IIXEK to capture and identify the target protein that interacted with IIAEK (1). We evaluated the specific interaction between IIAEK and the target protein using surface plasmon resonance (SPR). We studied whether IIAEK targets intestinal alkaline phosphatase (IAP) to improve cholesterol metabolism using IAP siRNA. We found that IIAEK significantly reduced the expression of intestinal cholesterol metabolism-associated genes, particularly ATP-binding cassette transporter A1 (ABCA1). Through photoaffinity labeling and MS analysis with IIXEK for intestinal lipid raft fractions of Caco-2 cells and rat intestinal mucosal proteins, we identified IAP as a specific molecule interacting with IIAEK (1). Surprisingly, SPR study showed the specific interaction of IIAEK with human IAP was 2.63 times stronger than that of *in vivo* substrate of IAP (vitamin B_6). Interestingly, IAP siRNA treatment counteracted the IIAEK-induced decrease in ABCA1 mRNA level in Caco-2 cells. We found that IIAEK specifically interacted with IAP in the amino acid sequence-dependent manner to improve cholesterol metabolism with a specific activation of IAP and downregulation of ABCA1 (1).

2] FP

We discovered a novel cholesterol-lowering dipeptide FP (phenylalanine-proline) from 400 dipeptides. We evaluated cholesterol-lowering effects of FP *in vivo and in vitro*, including *PepT1 KO mice.* Wistar male rats, wild-type C57BL/6J male mice and *PepT1* KO mice were fed a high-fat, high-cholesterol diet with a FP treatment to evaluate its effects on lipid metabolism (2). Cholesterol absorption, serum and liver cholesterol, liver lipids were significantly decreased by FP treatment in rats and mice. FP significantly decreased ABCA1 mRNA in the rat jejunum and reduced cholesterol absorption in Caco-2 cells. The cholesterol-lowering action induced by FP was disappeared in *PepT1* KO mice. We found that the cholesterol-lowering action of FP is mediated by PepT1 (2).

3] RPR

Dietary protamine can ameliorate hyperlipidemia; however, the protamine-derived active peptide and its hypolipidemic mechanism of action are unclear. We attempted to identify novel anti-obesity and hypocholesterolemic peptides derived from protamine in animal studies. We attempted to identify novel anti-obesity and hypocholesterolemic peptides derived from protamine in animal studies. We also investigated the effects of the novel anti-obesity and hypocholesterolemic peptide, Arg-Pro-Arg (RPR) derived from protamine, in mice.
C57BL/6J male mice were fed a high-fat diet with a RPR or protamine treatment to evaluate its effects on lipid metabolism (3).

The anti-obesity effects of protamine are linked to the upregulation of adipocyte PPARγ1 and hepatic PPARα and the downregulation of hepatic SCD1 via SREBP1 and adipocyte FAS.

RPR derived from protamine has a crucial role in the anti-obesity action of protamine by evaluating the effective dose of adipose tissue weight loss (3).

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Keywords: alkaline phosphatase, cholesterol, IIAEK, FP, RPR

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)1-04

Brain barrier transportable peptides and functions in mouse brain

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There have been few evidential *in vivo* studies that peptides can cross the blood-brain barrier (BBB) in their intact forms and their functions in brain. By *in situ* mouse perfusion experiments, peptides that can be transported across the BBB were screened and investigated about their functions in the brain. Freshly prepared perfusion fluid containing fluorescein isothiocyanate conjugated (FITC)-albumin or peptides (200 nmol/mL) was infused in the left ventricle of the heart by inserting a 26-gauge butterfly needle at a rate of 2.0 mL/min for up to 10 min. After the perfusion, the whole brain was removed from the mice by decapitation. By liquid chromatography-time-of-flight/mass spectrometry (LC-TOF/MS) and matrix assisted laser desorption ionization (MALDI)-MS imaging analyses, a significant influx of 13^{C}_{2}, 15^{N} Gly-Sar into the brain was obtained in the 10-min perfusion. Among 18 synthetic dipeptides based on the Gly-Sar skeleton, we found that Gly-Pro and Tyr-Pro can cross the BBB with K_i values of 3.49 and 3.53 µ L/g·min, respectively. No detection of Pro-Tyr, a reversed sequence of BBB transportable Tyr-Pro, also revealed the importance of peptide sequence for the transport. MALDI-MS imaging analysis of Tyr-Pro-perfused brain demonstrated that perfused Tyr-Pro was accumulated in the hippocampus, hypothalamus, striatum, cerebral cortex, and cerebellum of mouse brain. It was also demonstrated that the dipeptide improved an impaired memory by spontaneous alternation and shortened step-through latency in amyloid β-induced mice after daily administration for 16 days. In conclusion, Tyr-Pro is a brain-transportable peptide across the BBB and has a potential to improve amyloid β-induced memory dysfunction in mice by its oral administration.

Keywords: dipeptide, blood-brain barrier, MALDI-MS imaging

SY(T7)2-01

Collaborative immunomodulation by food components and microbiota in the small intestine

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Recent studies have revealed that various food components affect the immune response. These components act on various immune cells, and their effects are mediated through the intestinal immune system and, in some cases, the intestinal microbiota.

Chronic inflammation leads to various diseases. For example, obesity can cause chronic inflammation and this may lead to lifestyle diseases such as diabetes. Feeding high-fat diet (HFD) to mice elicits inflammation in adipose tissue, and can be utilized as a model for chronic inflammation. We have been using this model to investigate the anti-inflammatory effects of food components via the intestinal immune system.

We demonstrated in this model that feeding β-elemene, contained in herbs, alleviated inflammation in adipose tissue. Oral administration of β-elemene induced $Foxp3^{+}$ T cells, known to have anti-inflammatory functions, and decreased inflammatory M1 macrophages in adipose tissue. Furthermore, β-elemene acted on intestinal dendritic cells to induce $Foxp3^{+}$T cells in the intestinal immune system. Our study demonstrated the effects of β-elemene in treating experimental obesity-induced chronic inflammation by adjusting the balance of immune cell populations in fat tissue through the generation of regulatory T cells in the intestinal immune system by modulating dendritic cell function.

A different food material, namely a heat-killed lactic acid bacteria (LAB) preparation also inhibited inflammation of adipose tissue in HFD-fed mice. In this case, intestinal inflammation was alleviated, accompanying increase in gut barrier function which decreased by HFD-feeding. HFD feeding is known to cause dysbiosis of intestinal microbiota which was reversed by feeding this LAB strain. Our study demonstrated that the oral administration of the LAB strain regulated gut microbiota, suppressed intestinal inflammation, and improved the gut barrier. It was suggested that this inhibited translocation of products of obesity-induced gut dysbiosis, and through such mechanisms inflammation in adipose tissue was alleviated. We consider this as a case of collaborative immunomodulation by food components and microbiota in the small intestine and are now investigating the mechanisms.

These and other studies show that food components could act on the intestinal immune system directly, indirectly through intestinal microbiota, or through collaborative immunomodulation by both.

Keywords: Immunomodulation, Food, Intestinal immune system, Inflammation, Microbiota

SY(T7)2-02

Microbiome Targeted Therapy for Immune Disorders

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1. POSTECH (Korea), 2. ImmunoBiuome Inc (Korea)

Our immune system controls immunity toward pathogens and suppresses destructive hyper-immune responses. This immune homeostasis is maintained by concerted crosstalk between genetic factors and environmental cues, including intestinal gut microbiota. Dysregulation of the commensal flora

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

is closely linked to functional changes in the immune system and subsequently contributes to the development of immune disorders (such as autoimmunity, allergies), neuronal disorders (depression, Autism Spectrum Disorders), and metabolic syndromes. Moreover, altered gut microbiota affects differential responsiveness to immune checkpoint inhibitors, including anti-PDL1 or anti-PD-1 inhibitors. The candidates of microbiome therapeutics include bioactive molecules derived from the microbiome (metabolites and cellular components) and the bug itself (live biotherapeutic products, LBP). We have developed screening systems to identify anti-inflammatory and immune-stimulatory microorganisms to restore the dysregulated immune responses in various disorders. Furthermore, we have characterized the effector molecules from the selected bacteria and elucidated their mechanism of action. I will discuss the current status of microbiome therapeutic and our work on how we have identified B. bifidum PRI1 and CSGG (as the key effector molecule) that show anti-inflammatory properties to treat autoimmunity and neuronal developmental disorder in a pre-clinical model. I will also discuss immunostimulatory bacteria and their effector molecule that show synergic anti-cancer effects combined with immune checkpoint inhibitors.

Keywords: Microbiome, Live Biotherapeutic Products, Immune Disorders, Cancer, Inflammation

Conflict of Interest Disclosure: CEO of ImmunoBiome Inc.

SY(T7)2-03

Essential nutrients control the host immunity through collaboration with bacteria in the gut and fermented food

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Nutrition and commensal bacteria play a major role in the maintenance of immune function. Indeed, low nutrition, especially in essential nutrients, leads to a compromised immune system, which in turn leads to an increased susceptibility to infection. We are studying the immune functions of vitamins and oils, focusing on food and intestinal bacteria. For example, vitamin B families are involved in energy metabolism and are closely related to the maintenance of immune cell functions. In fact, when mice are maintained with a vitamin B1-deficient diet, impaired development and dysfunctions of immune cells with shrinkage of various lymphoid tissues such as Peyer's patches and thymus is observed. Even a deficiency of a single nutrient can cause significant immune dysfunction, but in some cases, it is not only the "quantity" of the nutrient but also its "quality" is important. One example is oil. Omega-3 and omega-6 fatty acids are known as essential fatty acids which cannot be synthesized by the body, so they are strongly influenced by food. They are known to be associated with immune regulations including inflammation and allergies, and recent developments in metabolome analysis have made it possible to reveal the effective lipid metabolites produced from each fatty acid. More recently, we show that beneficial lipid metabolites are produced not only by the body, but also by microorganisms such as bacteria in the gut and fermented food. These findings would lead to the clarification of the immune effects of nutrition from the perspective of "nutrition - bacteria - metabolism" is expected to make the realization of stratified/individualized nutrition that provides an optimal immune environment according to individual characteristics.

Keywords: Dietary oil, Microbiome, Vitamin

Conflict of Interest Disclosure: Some results were obtained from collaboration with Noster Inc. and Nippn Inc.

SY(T7)2-04

Novel roles of the aryl hydrocarbon receptor in the control of intestinal inflammation

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Genome-wide association studies have identified risk loci linked to Inflammatory Bowel Disease (IBD), a complex chronic inflammatory disorder of the gastrointestinal tract. The increasing prevalence of IBD in industrialized countries and the augmented disease risk observed in migrants who move into areas of higher disease prevalence suggest that environmental factors are also important determinants of IBD susceptibility and severity. However, the identification of environmental factors relevant to IBD and the mechanisms by which they influence disease has been hampered by the lack of platforms for their systematic investigation. Here, we describe an integrated systems approach, which combines publicly available databases, zebrafish chemical screens, machine learning and mouse pre-clinical models to identify environmental factors that control intestinal inflammation. This approach established that the herbicide propyzamide boosts inflammation in the small and large intestine. Moreover, we identified a novel AHR-NF-κB-C/EBPβ signaling axis that operates in T cells and dendritic cells to promote intestinal inflammation and is targeted by propyzamide. In conclusion, we developed a pipeline for the identification of environmental factors and mechanisms of disease pathogenesis in IBD and potentially, other inflammatory disorders.

Keywords: Autoimmunity, Immune regulation, Aryl hydrocarbon receptor, T cells, Dendritic cells

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)3-01

Anthocyanins and curcumin: Possible abilities to prevent diabetes and obesity by stimulating glucagon-like peptide-1 secretion and inducing beige adipocyte formation

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There is growing interest in the health benefits of natural plant pigments such as anthocyanins and curcumin. Anthocyanins are a group of naturally occurring phenolic compounds responsible for the color of many flowers, fruits (particularly berries), and vegetables. Curcumin is a polyphenol found in turmeric and is used as a spice, food coloring, and herbal medicine. At this symposium, I will describe how these pigments can help prevent diabetes and obesity by stimulating glucagon-like peptide-1 (GLP-1) secretion or by inducing beige adipocyte formation.

(Anthocyanins)

Our screening of the GLP-1 secretagogue suggested that delphinidin 3-rutinoside (D3R) increases GLP-1 secretion in vitro. Pre-administered D3R-rich blackcurrant extract (BCE) significantly ameliorated glucose tolerance after intraperitoneal glucose injection in rats by stimulating the secretion of GLP-1 and subsequently inducing insulin secretion. Dietary BCE significantly reduced blood glucose concentration and improved glucose tolerance, in association with increased basal GLP-1 concentration in plasma. This effect was accompanied by the upregulation of prohormone convertase 1/3 expression, which is essential for intestinal proglucagon processing and the production of GLP-1 in type 2 diabetic mice. An increase in endogenous GLP-1 secretion induced by food-derived factors may help to reduce the dosages of diabetic medicines and to prevent diabetes.

(Curcumin)

Curcumin has various biological functions, including anti-obesity and anti-diabetic properties. Several experimental animal and clinical trials indicate that curcumin has a suppressive effect on the accumulation of body fat. However, the molecular mechanisms by which curcumin exhibits anti-obesity and anti-diabetes properties through beige adipocyte formation are unknown. In addition, high doses of curcumin have been administered in most animal and human trials to date, due mainly to the poor water solubility of native curcumin and its low oral bioavailability. We demonstrated that a highly dispersible and bioavailable curcumin formulation (HC; 4.5 mg native curcumin/kg), but not the same dose of native curcumin, induces the formation of beige adipocytes in inguinal white adipose tissue (iWAT) in mice. We also examined two other approaches to enhance curcumin-mediated beige adipocyte formation and reduce the required functional dose.

1) Combination of HC and another food factor

We demonstrated that the co-administration of a lower dose of HC and artepillin C (a characteristic constituent of Brazilian propolis) significantly induced the development of beige adipocytes in iWAT in mice. Artepillin C enhances the generation of local norepinephrine from accumulated alternatively activated macrophages in iWAT mediated by HC.

2) Combination of exercise and HC Exercise provides various benefits for overall metabolic health. Exercise combined with food-derived factors may have significant or synergistic effects on increasing energy expenditure and suppressing body fat accumulation. Interestingly, the combination of exercise and administration of HC synergistically induced beige adipocyte formation, although exercise or HC alone did not. These unique findings suggest that curcumin can be used as a dietary supplement during exercise to enhance exercise-mediated health benefits.

Our studies are good examples of a curcumin formulation, or co-administration of curcumin formulation and other food-derived factors, enabling an effect that native curcumin cannot otherwise achieve.

Keywords: anthocyanins, curcumin

SY(T7)3-02

Cellular uptake and absorption of yellow curcumin and other compounds

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Lipids in our body can oxidize for various reasons, resulting in the formation of lipid peroxides which are believed to cause certain diseases. Therefore, it is important to reveal the type of oxidation reactions (radical oxidation, singlet oxygen oxidation, etc.) that take place in the body. In our laboratory, we have been aiming to clarify such types of oxidation reactions by analyzing the detail structures of lipid peroxides in vivo using mass spectrometric techniques1-3). We have hypothesized that we can effectively inhibit in vivo oxidation by selecting appropriate antioxidants according to the type of oxidative reaction; thus, we are conducting various experiments to prove this.

Curcuminoids, on the other hand, are yellow fat-soluble polyphenols found in turmeric. Among the oxidation reactions mentioned above, curcumin is known to be effective towards radical oxidation and has been reported to possess beneficial effects such as anti-tumor effects. However, the bioavailability of curcumin in humans is not high, thus, the true effects of curcumin may not be fully realized. Recently, we discovered that the affinity of curcumin to albumin is an important factor that affects the cellular uptake of curcumin4). Hence, an accelerated cellular uptake and physiological activity of curcumin may be achieved by focusing on this affinity5).

Currently, various antioxidant polyphenols are marketed for the purpose of disease prevention. Further advancement of the above two studies (lipid peroxides and curcumin) should enable identification of the oxidative reactions that proceed in the body, leading to the development of new functional foods that can act effectively with a clear in vivo mechanism of action. In terms of curcumin, an increased bioavailability and a more effective inhibition of radical oxidation in vivo should be achieved. In this

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

symposium, I will present such efforts including examples of lipid peroxides, curcumin, and other antioxidant polyphenols.

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Keywords: lipid peroxides, curcumin, polyphenol

SY(T7)3-03

Anthocyanins: diet, metabolism, and physiological effects

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Anthocyanins have traditionally been studied for their colorant properties (i.e., used as dyes), while their use in nutrition is much more recent. Anthocyanins are primarily found in the diet in blue- and purple-colored berries and in natural food colorants. To a lesser extent, anthocyanins are consumed in wine, purple corn and carrots, black rice and hibiscus. It's calculated we consume on average between 10 and 20 mg/day from our usual diets, but these values can vary considerably, with high consumers reported to ingest 70-100mg/day, while those taking dietary supplements can consume much higher levels. Anthocyanins undergo many chemical reactions once ingested, including pH dependent chemical degradation, microbial catabolism, and human phase II metabolism, with most anthocyanin metabolites reported as microbial metabolites. Anthocyanin publications have experienced exponential growth since the 1990s, and while initial health research focused on antioxidant activity, modern therapeutic targets include: cardiometabolic disease, cancer, bone health, inflammatory conditions and cognitive function, to list a few. Activity has been reported on membrane transport, enzyme activity, microbial and tumor cell growth, endothelium-dependent and -independent vasodilation, energy expenditure and body weight. Despite 30 years of concerted research, the direct mechanisms of action of anthocyanins remain elusive, possibly as the field has focused primarily on the precursor anthocyanins, over their known microbial metabolites. In an attempt to pinpoint the possible mechanisms of action of anthocyanins, we have created **an MS^n** quantitative metabolomics database and analytical workflow to characterize the contribution dietary anthocyanins make to the human metabolome, with focus on microbial metabolites of anthocyanins. As online food compositional databases lack comprehensive metabolome details, our data-capture workflow utilized an evidence mapping protocol using PubMed, Web of Knowledge and SCOPUS. Here we aimed to capture compositional data relative to the "berry metabolome". Next, we developed a database of berry phytochemicals, with curation of compound synonyms matched to InChI key, physical and chemical properties (mass, formula) and database identifiers (i.e., PubChem ID, HMDB ID, PhytoHub, KEGG ID, CAS InChiKey, SMILES). The database allows interrogation of berry phytochemicals and their possible interactions with biochemical and disease pathways, utilizing data visualization techniques including self-organizing maps, node-link diagrams, sankey diagrams and other visual analytics techniques. Information curated and organized in the knowledge database facilitates the prediction of the bioactivity of anthocyanin-rich food consumption. Here we found anthocyanin metabolites (hydroxybenzoic acids, hippuric acids, hydroxyphenylacetic acids) mapped to metabolic and transport pathways and neuronal systems, linking to numerous disease pathways, including cardiovascular disease, cancer, nervous system and digestive systems diseases, mental disorders, metabolic and immune system diseases. These findings backup nutrition intervention and biomarker study findings, and suggest anthocyanins perturb common metabolic pathways which have downstream effects on disease pathways.

Keywords: Nutrition, Phytochemicals, Anthocyanins, Metabolism, Health

SY(T7)3-04

Colorful Carotenoids: Molecular Mechanisms and Implications for Chronic Disease Prevention

Xiang-Dong Wang[1]

1. Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, MA (USA)

Carotenoids are yellow, orange and red lipophilic pigments and occur widely in nature, and carry out a variety of important biological functions. Despite the earlier unexpected findings of the human intervention trials that were conducted to determine the protective effect of beta-carotene on the incidences of lung cancer found no protective effects, supporting evidence that indicates a protective role of fruits and vegetables rich in carotenoids in prevention of chronic diseases continues to be reported in human epidemiological studies and in mechanistic studies using cell culture and animal models. It is important to understand the roles of carotenoids and their derivatives in the process of chronic diseases, with special attention to their metabolism and biological actions, molecular targets, dose effects, and organ-specific effects. We have recently provided strong evidence-based scientific verification of two major carotenoids, lycopene and beta-cryptoxanthin, has anti-inflammatory and anti-carcinogenic properties in lungs and

livers. Additionally, differential mechanisms of carotenoid actions including endogenous cleavage by carotenoid cleavage enzymes and influenced by gut microbiome that may also have protective effects against obesity/cigarette smoking/excessive alcohol consumption-related complications. My presentation will provide an overview of carotenoid metabolism, and the molecular pathways involved in the anti-inflammation/tumorigenesis properties of carotenoids on human health and cancer development.

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Keywords: Nutrition, Carotenoids, Chronic diseases, Dietary Prevention

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SY(T7)4-01

Food in pace: how to cultivate and eat crops on the moon?

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1. Chiba University (Japan)

JAXA (Japan Aerospace Exploration Agency) Space Exploration Innovation Hub Center (hereinafter "Exploration Hub") has been working in study of the realization of the concept of "Lunar farming" on the moon since 2017

The Lunar Farming Concept Study Working Group of Exploration Hub carried out studies on crop cultivation technology, unmanned technology, recycling, and overall system. Crop production and resource recycling in a lunar-base farm is a key component for a food supply system to support long-term stay of human beings on the Moon. We use an artificial light-type plant factory (vertical farm) equipped with a hydroponic cultivation system instead of soil and control temperature, humidity, light, CO_2 gas, O_2 gas which are above-ground environmental factors necessary for plant growth. The main food crops that can be cultivated there are cereals, legumes, potatoes, nuts and seeds, leafy vegetables, fruit vegetables, and root vegetables.

Based on the Dietary Intake Standards, an index (estimated energy requirement) was determined for energy to avoid excess or a deficiency of energy intake. There were three types of indicators regarding nutrients to avoid insufficient intake (estimated average requirement, recommended dietary allowance, and adequate intake). There were also indicators to avoid health problems because of overdose (tolerable upper intake level) and indicators to prevent lifestyle-related diseases (tentative dietary goal for preventing lifestyle-related diseases), for a total of six indicators.

Based on these background, we selected 8 crop species and calculated the cultivation area needed to meet the energy and nutrient requirements. The crops are rice, soybean, potato, sweet potatoes, tomato, strawberry, cucumber and leafy vegetable such as lettuce. We also proposed examples of recipes for meals that can be created using these 8 crop species.

In this presentation, I will report the concept study and introduce how to cultivate these crops in a plant factory on the moon.

Keywords: Dietary Intake Standards, food crop, plant factory, space farming, vertical farm

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SY(T7)4-02

EDEN ISS: Analogue Testing of Plant Cultivation for Space

Daniel Schubert[1]

1. German Aerospace Center (Germany)

EDEN ISS: Analogue T Sustained human presence in space requires the development of new technologies to maintain environmental control, to manage wastes, to provide water, oxygen, food and to keep future astronauts healthy and psychologically fit. The cultivation of higher plants in dedicated greenhouse modules is advantageous from this regard due to their ability to be used for food production, carbon dioxide reduction, oxygen production, water recycling and waste management. Furthermore, fresh crops are not only beneficial for human physiological health, but also have a positive impact on crew psychological well-being.

Under the lead of DLR (Institute of Space Systems), the EDEN ISS project team focused on advancing bio-regenerative life support systems, in particular plant cultivation technologies and procedures for space and planetary habitats. Over the last four years, essential Controlled Environment Agriculture technologies were designed, developed and integrated within the Mobile Test Facility, consisting of two interconnected 20 ft shipping containers. During a dedicated analogue test mission at the German Neumayer III research station in Antarctica, the greenhouse system provided a variety of fresh pick-and-eat crops for the overwintering crew of 10 members. This was of particular importance during their 8 months long isolation phase, when no plane or ship resupply of the station occurred.

The presentation will give a general overview the project and focuses on the deployment- and isolation phase of the EDEN ISS research platform in Antarctica.

Keywords: Bio-reversative Life Support Systems, Space Food, Analogue Testing, Controlled Environment Agriculture Technologies

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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SY(T7)4-03

Material recycling plant production system for life support in space

Yoshiaki Kitaya[1]

1. Osaka Metropolitan University (Japan)

Plant culture in space has recently been of more significant concern as the possibility of realizing human-crewed space flights over a long duration and even human habitation on other planets is increasing. The feasibility of achieving long-duration human-crewed space missions will be highly dependent on the controlled ecological life support systems (CELSSs) centered upon crop production in space farming. Plants will play essential roles in food production, CO_2 conversion, and water purification. Space farming will require establishing appropriate plant culture facilities with scheduled crop production and high yields with a rapid turnover rate. Here I will outline topics on fundamental knowledge about expected plant functions in the CELSS and the development of closed plant production facilities in space, including problems for growing healthy plants over a complete ontogenetic cycle in space farming. I summarize the possible effects of low gravity on plant growth and reproduction because of heat and gas exchanges between plants and the atmosphere. The challenges regarding environmental control under low gravity conditions in space are also considered. Sweetpotato is one of the candidate crops in space farming. Sweetpotato culture has many advantages over the culture of other crops because sweetpotato grows rapidly with less requirement of fertilizer and water for culture compared with other candidate crops. Sweetpotato has a high yield of edible biomass with high nutritional values allowing a little inedible part as waste because it can be utilized for the leafy vegetable as an antioxidative functional diet as well as the root crop as a high energy diet. The concept of CELSS can be developed into urban ecosystems incorporated with agriculture and the effective utilization of biomass. Assuming that the amount of input material from outside the system and input energy other than solar energy can be minimized, we get closer to a material recycling society with a less environmental load. The Earth is an almost entirely closed environment where plants, humans, and other heterotrophs coexist. Therefore, CELSS can be considered as a miniaturization of the material recycling system on Earth.

Keywords: Controlled ecological life support system, Material recycling system, Space farming

SY(T7)4-04

Crickets as the food of the future

Sumihare Noji[1]

1. Tokushima University (Japan)

It has been reported that by 2050, the population of the earth may exceed 10 billion. As a result, food shortages are expected to occur. Especially, the demand for protein will exceed our ability to procure it. On the other hand, increased protein production dependent on conventional livestock using cattle and pigs is known to accelerate global warming and induce climate change. To overcome this situation, insect diets are currently attracting attention. Crickets, in particular, are expected to be the food of the future, because they are omnivorous and can be farmed at high densities in an environmentally friendly manner. We have been studying crickets for more than 25 years and have used our knowledge to research ways to make crickets an efficient food source. In particular, we are developing methods to effectively raise crickets by using food residues and other materials that humans have not been able to eat or left uneaten. In addition, we are also conducting research on the domestication of crickets using genome editing technology to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

optimize their use as a food source. We are also studying the use of cricket excrement as fertilizer for plants. If crickets can be used as a virtuous eco-cycle food source, it may be possible to produce food not only on Earth, but also in extreme environments such as outer space. We will present the results of our research and the current status of cricket food in Japan. This study was conducted in collaboration with Drs. Takahito Watanabe, Taro Mito, and Katsuyuki Miyawaki.

Keywords: Crickets, Proteins, Climate change, Space, Recycling

SY(T7)4-05

Anti-muscle atrophy effects of polyphenols

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Loss of skeletal muscle mass is the consequence of various conditions including disuse, aging and disease. An elevated oxidative stress related to mitochondrial dysfunction is considered as one major contributor of muscle atrophy, though the underlying molecular mechanisms are not fully understood. Polyphenols, plant-based compounds with antioxidant and anti-inflammatory properties, have thus a potential as complementary therapies to prevent the loss skeletal muscle mass and function in various muscle disorders. During the 2 last decades, basic-research studies confirmed significant effects of polyphenols in counteracting muscle damages in several in-vitro and in-vivo muscle atrophy models. In these studies, polyphenol compounds appear to mainly act by reversing mitochondrial dysfunction. Interventional studies in humans are however sparse. A few studies led to encouraging beneficial effects in different physiological and pathological states such as aging, sedentary behavior and disuse, metabolic diseases, and malnutrition. More comprehensive research and additional controlled clinical trials are still needed to better clarify the place of specific polyphenols compounds in preserving skeletal muscle in human and identify the molecular and cellular underlying mechanisms.

Keywords: polyphenols, muscle, sarcopenia

SY(T7)4-06

Circular Food Production System Using Algae & Animal Cell Culture

Tatsuya Shimizu[1]

1. Tokyo Women's Medical University (Japan)

As future sustainable food production in outer space and in a lunar base, we propose circular cell culture of algae/animal cells and three-dimensional tissue fabrication using those cells. Currently, grain cultivation and livestock breeding with grain are carried out for producing foods. It exploits vast land surfaces on the earth, and only edible parts of these organisms are used as food. Additionally, the non-edible part has a large environmental impact. Such a food production system is not suitable in confined space like outer space and lunar base. Therefore, we have challenged novel food production system based on culturing cells which are the basic units of all living organisms that provide food. Our basic idea is that grain is replaced with algae and livestock is replaced with animal cells. Algae can be cultured and expand with photosynthesis. Then animal cells are cultured and expand with culture medium including basic nutrients (glucose, amino acids and vitamins) extracted from algae. Furthermore, animal cell culture wastes including ammonia are re-used for algae culture. These circular cell culture might lead to minimization of the space for food production. We have already demonstrated the expansion of both algae (chlorococcum littorale) and animal cells (C2C12 myoblasts) in the circular cell culture. By improvement of medium recycling efficiency, we are now trying to develop a totally circular cell culture system. Regarding 3-D muscle-like tissue fabrication, there are several tissue engineering technologies. The most popular approach is tissue engineering using 3-D scaffold. However, in most cases, the scaffold is problematic in the point of view SDGs. In some cases, natural polymers including collagen and gelatin are used as scaffolds, which are obtained from animals. In other cases, synthetic polymers are used, which needs complex synthetic process. On the other hand, we have developed original tissue engineering technology which layers 2-D cell sheets without any scaffolds. Three-D muscle-like tissues (cultured meat) have been engineered by layering bovine muscle cell sheets. In the future, additional developments should lead to a sustainable cultured food production system using the circular cell cultures and tissue engineering in limited and confined spaces. The technology will be also applicable to sustainable food production on the earth.

Keywords: cultured meat, cell culture, algae, cell sheet

Conflict of Interest Disclosure: I am a stakeholder of CellSeed Ink. Tokyo Women's Medical University receives the research grant from CellSeed Ink.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)5-01

Bioinformatics and Computational Biology-in the Discovery of Dietary Peptides with Angiotensin Converting Enzyme-I Inhibitory Activity

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1. University of Nebraska-Lincoln (USA)

Present research on dietary bioactive peptides suggests that these peptides can contribute to the prevention of developing non-communicable disease pathogenesis ranging from cardiovascular disease to cancer. Hypertension or high blood pressure is one of the primary causes of morbidity and mortality worldwide. Renin-angiotensin-aldosterone system (RAAS) is one of the significant pathways of blood pressure regulation, and Angiotensin-converting enzyme-I (ACE-I) is a critical component of the RAAS pathway. Inhibition of ACE-I is a well-known method of regulating blood pressure. Food-derived peptides with ACE-I inhibitory activities are receiving significant research attention due to the global prevalence of hypertension. However, identifying, and characterizing ACE-I inhibitory peptides from different food proteins is labor-intensive and time-consuming. This study developed bioinformatics and a dynamic molecular docking-based web server to quickly predict the ACE-I inhibitory peptides from other food proteins. This independent web server can take input in FASTA format or UniProt ID to perform the in silico gastrointestinal digestion and then screen the resulting peptides for ACE-I inhibitory activity. The web server also provides the structural features of the active peptides and their interaction with ACE-I through the dynamic molecular docking method. Therefore, this web server can instantly identify and characterize novel ACE-I inhibitory peptides produced after the gastrointestinal digestion of different food proteins. Furthermore, we have applied the approach of machine learning to predict novel ACE-I inhibitory peptides from the concerned food proteins. This enables us to develop an advanced platform for generating and predicting food-protein-based ACE-I inhibitory peptides with antihypertensive activity.

Keywords: Bioinformatics, ACE-I inhibition, Hypertension, Molecular docking, Bioactive peptides

SY(T7)5-02

Visualization of flavor perception

Takeshi Imai[1]

1. Kyushu University (Japan)

Foods contain a variety of volatile chemicals that create unique flavors. Olfaction is essential for the recognition of flavors, representing nutrients and their conditions in foods. Mammals detect odorants with odorant receptors expressed by olfactory sensory neurons in the nasal cavity. Each olfactory sensory neuron expresses only one type of odorant receptor out of a repertoire of ~1,000 in mice and ~400 in humans. Olfactory sensory neurons expressing the same type of odorant receptor converge their axons to the same location within the olfactory bulb, the first relay station in the brain, allowing for parallel processing of different inputs. We study odor perception in the mouse olfactory system using in vivo calcium imaging. In this talk, I will present an emerging new logic for how naturalistic odors are detected and processed in the peripheral olfactory system.

Keywords: Olfaction, Odorant receptor, Olfactory sensory neurons, In vivo imaging

SY(T7)5-03

Visualization of taste

Keisuke Sanematsu[1]

1. Kyushu University (Japan)

Tastes play an essential role as sensors for the uptake of nutrients to maintain homeostasis and for the avoidance of toxic substances. However, it is not easy to objectively evaluate human taste sensitivity in psychophysiological study due to subjectivity. Visualization of taste is one of the powerful tools to elucidate how taste receptors interact with taste substances. Here, we used functional assay and molecular dynamics simulaition to visualize the function of the G-protein-coupled sweet receptor, TAS1R2/TAS1R3. Calcium imaging for HEK 293 cells heterologously expressing TAS1R2/TAS1R3 clarified the molecular mechanisms of the interactions between the sweet taste receptors and taste modifiers. In addition, molecular dynamics simulations predicted dynamic allostery for the transmembrane domain of TAS1R3. Our simulations reproduced species-specific sensitivity of the sweet taste receptor to allosteric modulators. Upon receptor activation, the allostery induced by positive allosteric modulator agonist destabilized the intracellular part of the TAS1R3, an interface of the Gα subunit, along with ionic lock opening. Our predictions were supported by the functional assays of a common human variant of the TAS1R3. This study provides important insights not only for the visualization of taste receptor function but also for predicting dynamic activation for other G-protein-coupled receptors.

Keywords: Sweet taste receptor, Allostery, Molecular dynamics, Calcium imaging

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)5-04

Visualization of food polyphenols by matrix assisted laser desorption/ionization mass spectrometry imaging technique

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Food polyphenols, which found in tea, coffee, and a variety of fruits and vegetables, have been recognized as an important sources of nutraceuticals owing to their antioxidant, anticancer, antidiabetic, and anti-cardiovascular properties. In order to evaluate bioavailability of polyphenols, analytical tools such as liquid chromatography-mass spectrometry (LC-MS) techniques have been developed and applied Matrix-assisted laser desorption/ionization mass spectrometry imaging (MALDI-MSI) is a promising *in situ* analytical tool allowing for simultaneous visualization of drugs or food compounds in the organs. However, poor MALDI-MS detection of polyphenols in some common matrices requires more appropriate matrix for MALDI-MS of polyphenols. Thus, our primarily objective was to develop a new matrix for negative MALDI-MS of polyphenols. According to the photobase generator property of nifedipine under ultraviolet (UV)-irradiation, our results demonstrated for the first time that nifedipine successfully achieved the higher and selective MS detection of a model bioactive polyphenol, epigallocatechin-3-*O*-gallate (EGCG) in negative MALDI-MS. Of the dihydropyridines investigated, only nifedipine with *ortho*-positioned nitro group facilitated the detection of EGCG, suggesting that the nitrosophenyl pyridine photobase derived from nifedipine by UV-dehydration reaction under laser irradiation at 355 nm was a key player in deprotonation of polyphenols in negative MALDI-MS. Our further study was performed to establish an *in situ* MALDI-MSI visualization technique for investigating intestinal absorption and metabolism of polyphenols. In this research, two representative bioactive polyphenols, i.e. a *non*-absorbable theaflavin-3'-*O*-gallate (TF3'G) and an absorbable epicatechin-3*O*-gallate (ECG), were selected for MALDI-MSI after their intestinal transport experiments. The results showed that the nifedipine/phytic acid-aided MALDI-MSI technique provided the first *in situ* evidence on local distribution of these polyphenols in small intestine. Interestingly, visualized localization of TF3'G in rat intestine illustrated non-absorbable polyphenol could incorporate into intestinal tissue followed by efflux out to apical compartment. Combination of the present MALDI-MSI with inhibitor-aided intestinal transport experiment of polyphenols was found to be useful for elucidating intestinal absorption routes of TF3'G and ECG. The visualized results demonstrated that TF3'G was stable against phase II metabolism, while the non-targeting visualization by MALDI-MSI revealed the rapid phase II metabolism of ECG to form methylation, sulfation, and their combination conjugates in the small intestine. In conclusion, the present nifedipine/phytic acid-aided MALDI-MSI technique must be a powerful and novel *in situ* analytical tool for investigating intestinal absorption and metabolism of polyphenols without any labelling or extraction preparation steps.

Keywords: MALDI-MSI, Polyphenols, Visualization

SY(T7)6-01

Application of foodomics for evaluation of food quality

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1. Kogakuin University (Japan)

Foods are composed of various ingredients, the composition of which controls the characteristics of each food. Their composition depends on many steps during food production, such as food material, cooking/processing conditions, and fermentation conditions, etc. Therefore, quality of each food cannot be evaluated by only specific limited ingredients, but comprehensive analysis is required for food. Recently, foodomics approach, which is based on metabolomics by comprehensive metabolite analysis, has been arisen as effective to elucidate food quality. Especially, odor or aroma as flavor in food directly affects our appetite and preferences for it. Therefore, here, evaluation of food focusing on comprehensive flavor profiles and its application are introduced based on our research. Application of foodomics on various foods such as herbs, vegetables and processed food enabled to differentiation of samples and identification of key ingredients involved in it. Furthermore, biosynthesis of these characteristic ingredients, factors for their generating conditions, their relationship with sensory evaluation were leaded, indicating that foodomics is a useful approach to elucidate qualitative difference of foods.

Keywords: foodomics, metabolomics, flavor

SY(T7)6-02

Antioxidant compounds in the mushroom *Boletopsis leucomelas* (PERS.) FAYOD and how they change via cooking

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1. Japan Women's University (Japan)

Reactive oxygen species (ROS) are produced via several endogenous and exogenous processes and damage important biomolecules, such as lipids, proteins, and DNA. The accumulation of oxidative damage is one of the primary determinants of aging and occurrence of diseases such as autoimmune diseases, neurodegenerative disorders, multiple types of cancer, diabetes mellitus-related complications, stroke, heart attacks, pain and inflammation. Because intake of antioxidants may help prevent cellular damage and diseases mediated by free radicals, several studies have been conducted to investigate the therapeutic effects of antioxidants.

Because antioxidant activity of compounds can be easily evaluated via lipid peroxidation-inhibiting activity, which reflect

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

an accumulated effect of ROS and the deterioration of biological systems, we searched for new natural antioxidants in foods using this assay, and found that the mushroom, *Boletopsis leucomelas* (PERS.) FAYOD, possesses potent lipid peroxidation-inhibiting activity. Mushroom *Boletopsis leucomelas* (PERS.) FAYOD (Japanese name: kurokawa) has a bittersweet taste and is widely consumed worldwide, including Eastern Asia and Europe.

Antioxidant compounds in the mushroom *Boletopsis leucomelas* (PERS.) FAYOD were isolated using chromatographic methods, and their structures were determined via detailed analyses using high-resolution atmospheric pressure chemical ionization mass spectrometry and nuclear magnetic resonance. We identified five known *p*-terphenyl compounds (Bl-I, Bl-II, Bl-III, cycloleucomelon-leukopentaacetat, and Bl-IV) and one *p*-terphenyl new compound (Bl-VI); we determined the complete structure of cycloleucomelon-leukopentaacetat in this study. All these compounds possess potent lipid peroxidation-inhibiting activities. We further investigated changes in their chemical structures and antioxidant activities by applying heat (grilling, boiling, and microwave heating), and proved the production of two known *p*-terphenyl compounds (BI-V and boletopsin A) and one new *p*-terphenyl compound (BI-VII) via deacetylation of the original *p*-terphenyl compounds for the first time. We also found that DPPH radical scavenging activity was enhanced upon moderate heat cooking (boiling and microwave heating) due to changes in *p*-terphenyl compounds.

Keywords: Boletopsis leucomelas (PERS.) FAYOD, antioxidant activity, p-terphenyl compounds, heating

SY(T7)6-03

Visualization of food function using LC-MS

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1. Kyoto University (Japan)

Recently, the “double burden of malnutrition”, that is the coexistence of overnutrition (obesity and overweight) alongside undernutrition (stunting and wasting) became a serious problem all over the world. In particular, obesity has become a serious problem in advanced societies. Dyslipidemia and glucose metabolism disorder, which result from obesity, are recognized risk factors for serious disorders including arteriosclerosis, hepatic steatosis, insulin resistance, diabetes, and cardiovascular disease. Therefore, the avoidance of dyslipidemia and glucose metabolism disorder is important for the prevention and treatment of these diseases.

Lifestyle plays an important role in the avoidance of obesity. The appropriate dietary habits as well as exercise and nutritional status reduces the risk of serious diseases induced by obesity. Accordingly, studies on food function contribute to health-related quality of life.

Food is a complex containing not only nutrients but also bioactive compounds. Our study focuses on the effect of the bioactive compounds on health. For example, we analyzed the compounds contained in Koji using LC-MS. Koji is made from grains (e.g. rice, wheat, and soybeans) fermented with *Aspergillus oryzae* and essential for the production of many Japanese traditional foods including miso, soy sauce, and sake. We identified hydroxy-octadecadienoic acids contained in Koji as peroxisome proliferator-activated receptor (PPAR) α activators. PPARα is expressed at high levels in the liver, where it promotes β-oxidation via enhancement of the expression of its target genes. Therefore, PPARα activation is important for the improvement of diseases related to lipid metabolism dysfunction. We also demonstrated that both the PPARα activator and Koji induce the mRNA expression of peroxisome PPARα target genes and reduce triglyceride accumulation in murine hepatocytes. These effects were not observed in PPARα-KO hepatocytes. We therefore conclude that Koji contains valuable food-derived compounds which are capable of improving dyslipidemia.

For several decades, studies on food function have revealed the presence of many bioactive compounds capable of avoiding dyslipidemia and glucose metabolism disorder. However, the effect of food on health remains poorly understood. This is because food contains too many micro-compounds, making it difficult to identify. One of problem-solving approach is the assembly of new comprehensive assessment of food function using metabolome analysis. Metabolome analysis based on liquid chromatography coupled with ultra-accurate mass spectrometry is essential for an overview of food compounds (foodomics), and has been applied to the investigation of animals, plants, and humans. This enables the determination of molecular formulae, from precise mass data, and subsequent identification is provided by a metabolite database. This is an effective approach to analyze bioactive compounds and animal metabolites. The application of metabolome analysis to the assessment of food function using *in vitro and in vivo* contributes to comprehensive understanding of the effect of food on health near future.

Keywords: Food function, Obesity, LC-MS, Metabolome analysis

Conflict of Interest Disclosure: The author declares the following financial support which may be considered as potential conflict of Interests: Marukome Co., Ltd. and Kagome Co., Ltd.

Further Collaborators: Tsuyoshi Goto, Manabu Kitagawa, Shinsuke Mohri, Hiroyuki Suganuma, Nozomu Sakurai, Kazuo Inoue.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)6-04

Molecular interaction of functional food ingredients with biological components

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1. Tokyo University of Agriculture (Japan)

Food ingredients show various biological activities, which are functional, toxic, or both. These activities are typically triggered by specific molecular interactions, such as substrate-enzyme, ligand-receptor, lectin-sugar or antigen-antibody, although hydrophobic molecular interactions with phospholipid membranes are also sometimes important. Ingredients in tea infusions, such as caffeine, theanine, catechins and theaflavins show specific interactions. Caffeine inhibits phosphodiesterase after binding with the adenosine receptor, causing an increase in cyclic AMP and subsequent release of adrenaline. This leads to stimulation of the central nervous system and many other ensuing effects. Theanine is the ethylamide derivative of glutamic acid and provides an umami taste after specific interaction with the umami receptor in taste buds. Epigallocatechin gallate (EGCg), a tea catechin, interacts with the 67-kDa laminin receptor to cause various effects. The covalent binding of catechins and theaflavins with amino acid residues or proteins has been also reported. Recently, hydrophobic interactions between tea polyphenols and phospholipid membranes have attracted much attention. As an example, the antibacterial activity of EGCg is ascribed to interactions with cell membranes. Similarly, antioxidant activity towards low density lipoprotein, the growth inhibition of cancer cells, antiviral activity towards influenza virus, the induction of apoptosis in cancer cells, and astringency caused by tea polyphenols, have all been ascribed to hydrophobic interactions with phospholipid membranes. Biophysical parameters, such as partition coefficients, binding constants, inter-molecular and inter-atomic distances, and microscopic images, should be analyzed to elucidate the mechanisms of these hydrophobic interactions. We are investigating the molecular interactions of black tea polyphenols with phospholipid vesicles to elucidate the mechanisms underlying astringency, the inhibition of cholesterol absorption, and the inactivation of viruses. We have developed an improved method to analyze the turbidity of small volumes of vesicle solutions and use the results as an indicator of molecular interactions with phospholipid membranes. The use of a portable visible spectrophotometer with an LED detection system allows rapid turbidity analysis, such as our analysis of the dose-dependencies of respective catechins and theaflavins on the turbidity of phospholipid vesicle solutions. We found that theaflavins generally cause aggregation of the vesicles at much lower concentrations than do catechins, reflecting the higher hydrophobicity of theaflavins compared to catechins. Theaflavin-3-*O*-gallate (TF2A) and theaflavin-3,3'-di-*O*-gallate (TF3) caused the aggregation of phospholipid vesicles with higher turbidities than did theaflavin-3'-*O*-gallate (TF2B) at the respective concentrations. An NMR study providing chemical shifts, nuclear Overhauser effect, and relaxation times revealed that the galloyl moiety of TF2A interacts with the choline moieties of phospholipid head groups more closely than that of TF2B. These results indicate that the presence of a galloyl moiety at a specific location in the molecule is important for the interactions. The polyphenols in black tea infusions may synergistically interact with phospholipid vesicles, and the compounds other than the known polyphenols may also be due to such molecular interactions.

Keywords: black tea, polyphenol, catechins, theaflavins, phospholipid

SY(T7)7-01

67-kDa laminin receptor mediates the beneficial effects of a green tea polyphenol EGCG

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Green tea is one of the most consumed beverages in the world. Several clinical and animal studies have shown the beneficial effects of green tea. (−)-Epigallocatechin-3-*O*-gallate (EGCG) is one of the major compounds in green tea, and several studies emphasize its central role in the beneficial effects of green tea. EGCG is known to exhibit various biological and pharmacological properties. 67-kDa laminin receptor (67LR) has been identified as a cell-surface EGCG receptor that confers EGCG responsiveness to cancer cells at physiological concentrations. 67LR has been shown to mediate the beneficial activities of this phytochemical, such as anti-atherosclerosis, insulin sensing modulation, anti-allergic, and anti-inflammatory activities. MYPT1, eEF1A, protein phosphatase 2A, Akt, endothelial nitric oxide synthase, soluble guanylate cyclase, protein kinase Cd, acid sphingomyelinase, sphingosine kinase 1 and cGMP are EGCG-sensing relating molecules that are vital, via 67LR, for EGCG activities *in vivo*. Some drugs and food factors potentiate bioactivities of EGCG by modulating the EGCG-sensing pathways. My presentation focuses on highlighting the current understanding of EGCG sensing mechanisms through 67LR by which EGCG exerts biological properties.

Keywords: EGCG, sensing, cGMP, 67LR

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)7-02

Bioavailability and biotransformation of tea polyphenols: how the biotransformation affects our understanding of the beneficial health effects of tea polyphenols

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Background and objectives: Tea is one of the most popular beverages in the world. Consumption of tea has been associated with many health benefits including the prevention of cardiovascular disease, cancer, and obesity. These effects are attributed to the polyphenol compounds in tea with catechins being the major components in green tea and theaflavins (TFs) and thearubigins (TRs) as the unique compounds in black tea. In general, tea polyphenols are extensively metabolized in vivo and have poor systematic bioavailable. It is puzzling how tea polyphenols generate in vivo efficacy if they are poorly bioavailable. We hypothesized that tea polyphenol metabolites retain their bioactivities. The objective of our studies is to dissect the metabolic profiles of tea polyphenols using knowledge-based targeted and untargeted metabolomic approaches.

Methods: Using LC/MS based targeted and untargeted metabolomic approaches, we systematically studied the biotransformation of epigallocatechin 3-gallate (EGCG), TFs, and TRs in mice and humans.

Results: We identified several new metabolic pathways of EGCG including cysteine conjugation, glucosidation, oxidation, conjugation with reactive carbonyl species, and amination. Some of the new metabolites, such as cysteine conjugated EGCG and the aminated EGCG retain the bioactivities of EGCG. Furthermore, we studied the metabolism of TFs and TRs especially their microbial metabolites. For TFs, we identified the oxidized and aminated metabolites as well as the microbial degradation products. For TRs, we found that tea catechin dimers, such as TFs, and theasinensins, are also the building blocks of TRs.

Conclusions: Several new metabolic pathways of tea polyphenols were identified, suggesting the bioavailability of tea polyphenols was underestimated in the past. Microbiota has the potential to metabolize tea polyphenols to small molecular bioavailable metabolites.

Keywords: tea, bioavailability and biotransformation, microbial metabolism, tea polyphenols, metabolomics

SY(T7)7-03

Food bioactives on gut and brain health

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This study was aimed to compare the beneficial effect of catechin-enriched green tea and Oolong tea on mildly hypercholesterolemic and mild cognitive impairment (CDR=0.5; clinical dementia rating score) subjects. Sixty subjects (180-220 mg/dL) were enrolled and divided into three groups as catechin-enriched green tea (CEGT), catechin-enriched oolong tea (CEOT) or placebo. Subjects were instructed to drink (2 x 300 mL) of CEGT (780.6 mg of catechin), CEOT (640.4 mg of catechin) or placebo beverage for 12 weeks. Drinking CEGT and CEOT significantly decreased ($p < 0.05$) the body weight, fat, and BMI, lipid peroxidation as well as lipid profile (TC, LDL-c, HDL-c, and TG). Also, intervention with CEGT and CEOT significantly improved ($p < 0.05$) the oxidative indices (TEAC, GSH) and antioxidant enzymes (SOD, CAT, GPx, GR). Moreover, ultrasound examination endorsed the hepatoprotective activity of CEGT and CEOT by reverting mild fatty liver to the normal hepatic condition because of antioxidant and hypolipidemic activities. The feces amounts and the time to pass through intestine for both groups were all improved. For the dementia evaluation, all the subjects' CASIC2.0 score were also greatly reduced. To summarize, both CEGT and CEOT showed similar antioxidant and hepatoprotective activities. However, CEOT displayed superior lipid-lowering activity than CEGT or placebo, and also promote brain health, hence it could be urged to amend the wellness condition of mildly hypercholesterolemic and mild cognitive impairment subjects.

Keywords: green tea, oolong tea, hypercholesterolemic, mild cognitive impairment, CDR

SY(T7)7-04

Development of functional green tea and the use of functional food labeling system in Japan

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In 2015, Consumer Affairs Agency of Japan (CAA) launched a new food labeling system known as “Foods with Function Claims (FFC).” The system is characterized by the fact that in addition to general processed foods and supplements, fresh foods are also subject to labeling; businesses themselves, not the government, are responsible for safety and functionality; this is a notification system, and reported information is disclosed on the CAA's website before it is sold; and functionality includes "expression

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of a specific part of the body" and "evaluation by subjective indicators" can be used. As of June 21, 2022, 5576 FFCs have been launched, including 149 fresh foods such as Satsuma mandarin, tomato, spinach, soybean sprout, kale, eggplant, pumpkin, perilla leave, garlic, broccoli, green pepper, mushroom, apple, grape, pineapple, banana, bilberry, lemon, melon, barley, chicken, pork, egg, and fish. Tea (*Camellia sinensis L.*) has been found to exhibit various bioregulatory activities, such as being anti-oxidative, body fat reductive, anti-hypertensive, anti-hypercholesterolemic, anti-cognitive, anti-bacterial, and having immune regulatory effects. We have found the anti-allergic effect of epigallocatechin-3-*O*-(3-*O*-methyl) gallate (EGCG3″Me) and epigallocatechin-3-*O*-(4-*O*-methyl) gallate (EGCG4″Me) isolated from Japanese or Taiwanese tea leaves. EGCG3″Me strongly inhibit mast cell activation and histamine release after Fc epsilon RI cross-linking through the suppression of tyrosine phosphorylation (Lyn) of cellular protein kinase and the suppression of myosin light chain phosphorylation and high-affinity IgE receptor expression via binding to the 67 kDa laminin receptor. 'Benifuuki' was a tea cultivar to contain most EGCG3″Me. The human clinical studies showed that the nasal or eye symptoms of cedar pollinosis or perennial rhinitis were significantly relieved in 'Benifuuki' green tea containing 34mg/day of EGCG3″Me compared with placebo 'Yabukita' green tea that did not contain EGCG3″Me without affecting any normal immune response. One consecutive month of ingestion of 'Benifuuki' green tea was useful for the reduction of some symptoms caused by Japanese cedar pollinosis. Furthermore, the addition of ginger extract increased the anti-allergic effect. From these results, "Benifuuki green teabag", and "Memehanacha (ready to drink)" were released as the first anti-allergic FFC in 2015. The health claim of 'Benifuuki' green teabag was "it alleviates eye or nose discomfort caused by exposure to house dust or cedar pollens". Currently, 32 FFCs (tea bags, powdered tea, tea extract, etc.) containing *O*-methylated catechin as a functional ingredient were launched. As related studies, we found that the reducing effect of serum lectin-like oxidized LDL receptor-1 containing apolipoprotein B (LAB) level and the lowering effect of serum 1,5-anhydroglucitol level by long-term intake of 'Benifuuki' green tea, and developed a tea infuser "Rich plus" for rapidly extracting EGCG3″Me. FFCs, which were developed using other tea ingredients, has the following functional claims; Function to reduce body fat (tea catechins (recommended daily intake: 400-540 mg), gallate type catechins (150-340 mg), epigallocatechin gallate (EGCG, 300 mg), suppression of postprandial blood glucose increase (EGCG (140.2 mg), cognitive function to maintain cognitive function (theanine (200mg), theanine (50.3mg) plus EGCG (131mg)), support healthy sleep at night and reduce fatigue and drowsiness upon waking (theanine (200mg)).

Keywords: Foods with Function Claims, Benifuuki green tea, anti-allergic action

SY(T7)8-01

The creation of SHOKU-gaku (Transdisciplinary Science of Eating, Food, and Nutrition for Health and Wellbeing) and its goals: with an example of food function enhancement by the oral microbiome

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"Shoku-gaku" is a newly coined Japanese word, meaning "Transdisciplinary Science of Eating, Food, and Nutrition for Health and Wellbeing (TEFoN)". This is the world's first new transdisciplinary science that integrates oral science with the existing disciplines of food science and nutrition science. In 2020, Tohoku University Graduate School of Dentistry, in collaboration with Tohoku University Graduate School of Agricultural Science and Miyagi University School of Food Industrial Sciences, launched the concept of Shoku-gaku (TEFoN) and establish the Innovative Research and Education Center as a base for conducting this new science (iREC-TEFoN). The goal is to realize lifelong health and wellbeing by right eating and right food.

The topics covered in Shoku-gaku (TEFoN) are: 1. Oral function science: sensing of eating (chewing, swallowing, etc.) and tasting (taste, smell, texture, etc.), 2. Food science: functional foods and disaster foods, 3. Nutrition science: new functional food molecules and personalized nutrition, 4. Microbiome science: food-induced modification of oral/intestinal microbiome and food components modification and new functions by oral/intestinal microbiome, 5. Data science of eating, health and wellbeing. Based on these transdisciplinary activities, we will develop new functional foods that bring about health and wellbeing, and create "eating programs" for lifelong health and wellbeing. To utilize these results in society, social co-creation, including industry-academia collaboration, social demonstration, and social implementation, is essential.

In the past 20 years, the role of dentistry has been expanding from the prevention and treatment of oral diseases to the promotion of oral and systemic health. Since eating is the most important factor for the promotion of health and wellbeing, dentistry has the responsibility to conduct Shoku-gaku (TEFoN), as a discipline of the oral cavity, the gateway to food. From these perspectives, Shoku-gaku (TEFoN) will be one of the redefinitions and a new mission of dentistry in the future, which aims to promote oral and systemic health and wellbeing. At the same time, it will also be a great opportunity to finally include food science and nutrition science, which have not been included in dentistry and medicine in Japan, into the curricula of dentistry and medicine. Shoku-gaku (TEFoN) will shift medical and dental care to more proactive prevention, pre-disease control, and health promotion, enabling the revitalization of the super-aging society that humanity will soon face around the world.

In this presentation, we will discuss the concept of Shoku-gaku (TEFoN), its background and current activities. Furthermore, using nitrate as an example of one of the food components, we will explain how the oral microbiome may enhance food function and contribute to oral and systemic health.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Shoku-gaku, Oral science, Food science, Nutrition science

SY(T7)8-02

Lipopolysaccharide Neutralizing protein in Miso, Japanese Fermented Soybean Paste

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Intestinal flora typically amount to 100 trillion cells comprising 400 bacteria species. Gram negative bacteria of one kind in the flora have lipopolysaccharides (LPS), which stimulate intestinal activity. Fatality rates from severe diseases caused by LPS are 30–50%. According to recent probiotic theories of health, vigorous lactic acid bacteria in yogurt are eaten by many people to improve their intestinal environment. Moreover, some lactic acid bacteria reportedly have activity for neutralizing LPS from *Escherichia coli*. Actually, since ancient times, miso has been regarded as able to alleviate intestinal failure. Miso, a fermented paste made from soybeans, is used traditionally for seasoning of food. Since ancient times, it has been a dietary source of protein and nitrogen in Japan because of its high nutritional value and important health functions such as the estrogen-like activity of isoflavones, anti-oxidation, and angiotensin-converting-enzyme inhibition activity. Anti-inflammation effects of miso clearing mechanisms constitute a new healthy function. Today, similarly to yogurt, miso is regarded by many as a healthy food After some miso samples were analyzed, their LPS neutralization substrates were researched. First, their LPS neutralization activity was assayed. Consequently, only one miso sample has 85% elimination activity, 4 samples had 50–80% LPS neutralization activity, and 10 samples had 19–50% activity. The others failed to show activity. The one miso sample with the most neutralization activity among the samples also had the greatest amount of soluble nitrogen at 0.48%. Correlation analysis was conducted to assess LPS neutralization activity and other compounds in miso. The LPS neutralization activity was found to be related strongly with soluble nitrogen in miso; its coefficient *R* was 0.8329. A relation was found with fluorescent dye using ANS in miso. Therefore, LPS neutralization activity was found to have a relation with hydrophobic peptides in miso. Results indicate that miso neutralized LPS that might cause intestinal tract inflammation. After fractioning of miso, the LPS neutralization activity fractionations (proteins) were isolated from miso extract using Blue native polyacrylamide gel electrophoresis (PAGE). A protein found at 10–30 kDa on the polyacrylamide gel was identified using nano LC-MS/MS as 2S albumin in soybean (*Glycine max*). The protein had two LPS binding motifs: SKWQHQ (22 amino acid residues) and EKQKKKMEKE (131 amino acid residues). The protein in miso was found to have LPS neutralization activity, as assayed by prostaglandin D2 (PGD2) production from macrophage cells. Results show that LPS-neutralizing protein (LNP) from miso inhibited PGD2 production by macrophage cells. Particularly, 50 mg/mL of LNP solution and LPS (10 mg/mL) inhibited cell production of PGD2. Data were inferred as significantly different ($P < 0.05$) from results of statistical analyses by ANOVA testing and Tukey tests. The 2S albumin in soybean is LNP, an LPS-neutralizing protein produced in miso.

Keywords: lipopolysaccharides (LPS), Anti-inflammation, Miso, Japanese Fermented Soybean Paste

SY(T7)8-03

Recent discoveries on the effects of vitamin K on endocrine.

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1. Tohoku University (Japan)

Vitamin K is one of the fat-soluble vitamins and is mainly composed of vitamin K1 contained in plants and vitamin K2 (menaquinone) derived mainly from microorganisms. It has been shown that some of the ingested vitamin K is specifically converted in animal tissues to menaquinone-4 (MK-4), a type of vitamin K2. This MK-4 is known to have certain effects not found in other vitamin Ks.

Vitamin K acts as a cofactor for γ-glutamylcarboxylase and is an essential cofactor involved in post-translational modification (activation) of vitamin K-dependent proteins. Since vitamin K-dependent proteins include blood coagulation factors and bone matrix proteins, vitamin K plays an important role in blood coagulation and maintenance of bone homeostasis. On the other hand, vitamin K is also present in high concentrations in several tissues other than the liver and bones. Tissues such as testis and pancreas, where the action of vitamin K is not fully understood, contains relatively higher concentration of MK-4 in the regardless of the type of vitamin K ingested, suggesting that vitamin K, especially MK-4, could possess unknown functions.

We attempted to elucidate the novel function of vitamin K by analyzing the gene expression level of rat testis by the DNA microarray method. The expression level of a series of genes involved in the synthesis pathway of isoprenoid, cholesterol, and testosterone, including Cyp11a, a rate-determining enzyme to produce testosterone, were altered depending on the degree of vitamin K sufficiency. In addition, plasma and testicular testosterone levels were also significantly increased in the group with vitamin K supplemented diet compared to vitamin K deficient diet group, indicating that vitamin K could involve in androgen hormone production. In addition, an experimental system using testis Leydig cell lines also confirmed testosterone production dependent on the addition of vitamin K, suggesting that the cAMP-PKA-CREB-mediated pathway is involved in this mechanism.

We also conducted a study using the islets of Langerhans cell in the mouse pancreas to elucidate the function of vitamin K in the pancreas. We have shown that vitamin K enhances glucose-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

stimulated insulin secretion and may be involved in glycemic homeostasis. Furthermore, in a study using β-cell lines, it was also shown that vitamin K enhances glucose-stimulated insulin secretion in a concentration-dependent manner. As part of the mechanism, we have shown that it may be mediated by the exchange protein directly activated by cAMP 2 (Epac 2) pathway following the increase in intracellular cAMP concentration.

These results indicate that vitamin K may be involved in testicular androgen hormone production, and maintenance of blood glucose levels through pancreatic insulin secretion.

Keywords: vitamin K, testosterone production, Leydig cell, insulin secretion, cAMP

SY(T7)9-01

Natural polyphenols as therapeutic and preventive agents for Alzheimer's disease

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Epidemiological studies. Epidemiological studies have suggested that diets rich in polyphenols or phenolic compounds are associated with a reduced risk of dementia or Alzheimer's disease (AD). In our population-based cohort in Nakajima, Ishikawa, Japan, we have analyzed how lifestyle-related factors (diets/exercise and laboratory data) at baseline of normal cognition are related to future cognitive decline in a prospective, longitudinal study. We found that consumption of green tea, but not coffee or black tea, was associated with reduction of risk of cognitive impairment approximately 5 years after the baseline of normal cognition, after controlling confounding factors such as age, gender, lifestyle-related diseases, lifestyle-related factors, and apolipoprotein E E4. AD accounted for 67% of all causes of dementia in this cohort. As green tea is rich in polyphenols, we considered that natural polyphenols may have preventive effects on AD.

Effects of natural polyphenols in AD models. Polyphenols/phenolic compounds have anti-oxidant and anti-inflammatory properties. Furthermore, various polyphenols/phenolic compounds have been reported to have specific actions in AD models: modulation of amyloid precursor protein (APP) processing, inhibition of amyloid β-protein (Aβ) aggregation, destabilization of Aβ aggregates, promotion of Aβ clearance, alleviation of Aβ-induced oxidative stress/toxicity/synaptic dysfunction, and inhibition of tau phosphorylation and aggregation. Our studies with *in vitro* AD models revealed that some polyphenols, such as rosmarinic acid (RA) and myricetin, efficiently inhibit oligomerization as well as fibril formation of Aβ through differential binding, whilst reducing Ab oligomer-induced synaptic and neuronal toxicity. A transgenic mouse model fed orally with such compounds showed significant reduction of soluble Aβ oligomers as well as of insoluble Aβ deposition in the brain.

Clinical trials with natural polyphenols for AD. Several polyphenols or phenolic compounds, including curcumin, resveratrol, and (-)-epigallocatechin-3-galate (EGCG), have been investigated in clinical trials, although their efficacy in prevention or treatment for AD has not been established as yet. Based on the results of our studies with AD models, we proceeded to clinical trials with RA for prevention and treatment of AD/dementia. For clinical trials, we prepared capsules of *Melissa officinalis* (lemon balm) leaf extract rich in RA. A randomized-controlled trial (RCT) in healthy individuals confirmed safety, tolerability, and pharmacokinetics of the *M. Officinalis* extract (UMIN-CTR: UMIN000004997). Then, we performed an RCT with the RA-rich *M. officinalis* extract in patients with mild AD dementia, and found that the extract was safe and well-tolerated, and that Neuropsychiatric Inventory Questionnaire (NPI-Q) score significantly improved in the *M. officinalis* group compared with worsening in the placebo (P = 0.012), suggesting that the *M. officinalis* extract may improve neuropsychiatric symptoms (UMIN000007734). Currently, an RCT to elucidate the effect of the *M. officinalis* extract for dementia prevention in non-demented subjects is ongoing (UMIN000021596).

Conclusions. Beneficial properties of natural polyphenols/phenolic compounds for prevention and treatment of AD have been suggested in epidemiological and experimental studies. For clinical use, several compounds have been investigated by clinical trials, however, preventive or therapeutic effects on AD have not been proved so far, requiring further clinical trials to establish their efficacy.

Keywords: Dementia, Alzheimer's disease, Prevention, Diets, Polyphenols

Conflict of Interest Disclosure: None.

Further Collaborators: Moeko Noguchi-Shinohara, Kenjiro Ono, Tsuyoshi Hamaguchi, Shoko Kobayashi

SY(T7)9-02

Microbiota metabolites modulate the T helper 17 to regulatory T cell (Th17/ Treg) imbalance promoting resilience to stress-induced anxiety- and depressive- like behaviors

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Chronic stress disrupts immune homeostasis while gut microbiota-derived metabolites attenuate inflammation, thus promoting resilience to stress-induced immune and behavioral abnormalities. There are both peripheral and brain region-specific maladaptations of the immune response to chronic stress that produce interrelated mechanistic considerations required for the design of novel therapeutic strategies for prevention of stress-induced psychological impairment. This study shows that a combination of probiotics and polyphenol-rich prebiotics, a synbiotic, attenuates the chronic-stress induced

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

inflammatory responses in the ileum and the prefrontal cortex promoting resilience to the consequent depressive- and anxiety-like behaviors in male mice. Pharmacokinetic studies revealed that this effect may be attributed to specific synbiotic-produced metabolites including 4- hydroxyphenylpropionic, 4-hydroxyphenylacetic acid and caffeic acid. Using a model of chronic unpredictable stress, behavioral abnormalities were associated to strong immune cell activation and recruitment in the ileum while inflammasome pathways were implicated in the prefrontal cortex and hippocampus. Chronic stress also upregulated the ratio of activated proinflammatory T helper 17 (Th17) to regulatory T cells (Treg) in the liver and ileum and it was predicted with ingenuity pathway analysis that the aryl hydrocarbon receptor (AHR) could be driving the synbiotic's effect on the ileum's inflammatory response to stress. Synbiotic treatment indiscriminately attenuated the stress-induced immune and behavioral aberrations in both the ileum and the brain while in a gut-immune co-culture model, the synbiotic-specific metabolites promoted anti-inflammatory activity through the AHR. Overall, this study characterizes a novel synbiotic treatment for chronic-stress induced behavioral impairments while defining a putative mechanism of gut-microbiota host interaction for modulating the peripheral and brain immune systems.

Keywords: Gut-Brain-Axis, Neuroinflammation, Adaptive Immunity,, Aryl Hydrocarbon Receptor, Metabolome

SY(T7)9-03

The evidences of sulforaphane from animal and cell studies to prevent or treat Alzheimer's disease

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Sulforaphane, an organosulfur compound present in cruciferous vegetables, is known as one of the most powerful activator of transcription factor nuclear erythroid 2-related factor-2 (Nrf2). It has been shown to exert neuroprotective effects in experimental in vitro and in vivo models of neurodegeneration. The studies have further extended to several neurological diseases, including Alzheimer's disease (AD), Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis, multiple sclerosis, autism spectrum disorder, and schizophrenia. The potential effects of sulforaphane on cognitive function and the cholinergic system were investigated by evaluating learning and memory retention in C57BL/6 mice using the Morris water maze test and assessing cholinergic markers acetylcholine, acetylcholinesterase, and cholineacetyltransferase in C57BL/6 and primary cortical neurons exposed to scopolamine. The effect of sulforaphane on neuronal brain-derived neurotrophic factor (BDNF) expression and its tyrosine kinase receptor B (TrkB) synaptic signaling pathways were also investigated. Whether sulforaphane modulates the production of amyloid-β (Aβ) and tau, the two main pathological factors in AD, is also investigated using triple transgenic Alzheimer's disease mouse model (3XTg-AD). Finally, sulforaphane ameliorated memory deficits in 3 × Tg-AD mice as revealed by novel object/location recognition tests and contextual fear conditioning tests. On the other hand, biological indicators to predict sulforaphane's responders were reviewed under the concept of personalized nutrition. This work is supported by the Korea Research Foundation Grant given to Jiyoung Kim #NRF-2012R1A1A3011954, #NRF-2015R1A1A3A04000963 and #NRF-2020R1I1A1A01054684.

Keywords: sulforaphane, BDNF, Aβ, tau, Alzheimer's disease

SY(T7)9-04

Rosmarinic acid suppresses tau phosphorylation and cognitive decline by downregulating the JNK signaling pathway

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1. Seoul National University (Korea)

The number of patients with Alzheimer's disease (AD) is increasing rapidly worldwide; however, its definite treatment is not yet established. Therefore, food-based prophylaxis of AD is desired. Several epidemiological studies have indicated that a polyphenol-rich diet reduces the risk of AD. We found that rosmarinic acid (RA), a food-derived polyphenol, is a prophylactic candidate for AD. Our group has analyzed the mechanism of *in vitro* inhibition of Aβ aggregation, which is the main pathological hallmark of AD. However, the mechanism of RA activity *in vivo* remains unclear; therefore, we examined the effect of RA in AD model mice and investigated the underlying mechanism. First, we investigated the effect of RA on cognitive function in 3×Tg-AD mice using behavioral tests. In Y-maze and novel object recognition tests, 10-month 3×Tg-AD mice from the RA group exhibited improved behavioral performance for spatial cognition and object memory. Immunohistochemistry was performed to evaluate the expressions of Aβ and p-tau, which are key molecules of AD progression. The accumulation of Aβ was suppressed in the RA group. According to the proportion of p-tau-positive cells to the total number of cells in the hippocampus, there was a significant decrease in the CA1 region of the RA group relative to the control group. Then, we performed DNA microarray analysis of the hippocampus to elucidate the mechanisms of RA activity. KEGG analysis showed that inflammation-related pathways, such as MAPK/JNK signaling, were suppressed in the RA group. Furthermore, DNA microarray analysis showed that JnK3 was the most markedly downregulated tau kinase and RT-qPCR revealed decreased *JnK3* expression in the hippocampus. Immunohistochemical analysis showed lower expression levels of p-JNK and p-c-Jun in the CA1 region in the RA group relative to those in the control group, indicating attenuated JNK signaling in this region. Further, we

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

investigated the gene expression levels of the central and peripheral inflammatory mediators as potential factors that alter the activity of stress-associated JNK. In addition to the representative inflammatory mediators, such as *interleukin-1β* and *tumor necrosis factor-α*, reduced levels of chemokines and damage-associated molecular patterns were observed in the RA group at both the central and peripheral sites. Although inflammation was suppressed in both the periphery and brain, the order in which this suppression occurred is unclear. Recent studies have suggested that neuroinflammation significantly contributes to AD pathogenesis. Numerous preclinical and clinical studies have demonstrated that peripheral inflammation is communicated to the brain. Therefore, AD prevention should aim at suppressing the inflammation in both the periphery and brain. In our study, RA intake suppressed hippocampal inflammation and led to the downregulation of the JNK signaling pathway that induces tau phosphorylation. Supplementation with RA exerted an anti-inflammatory effect not only in the central nervous system but also in the peripheral organs. Downregulation of the JNK signaling pathway in the hippocampus may be a potential mechanism underlying the inhibition of the progression of AD pathology and cognitive deficit due to RA intake.

Keywords: Alzheimer's disease, polyphenol, rosmarinic acid, JNK, inflammation

SY(T7)10-01

A Perspective on Omega-3 Fatty Acids and Cardiovascular Disease from 40 Years of Research

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Omega-3 fatty acids burst into the scientific and medical world in 1971 with the first publication from Dyerberg and Bang about the Greenland Innuits. Their research was the first to link high blood omega-3 levels of EPA and DHA with reduced risk for cardiovascular disease (CVD). I was first introduced to EPA and DHA in the late 1970s when I studied their effects on human lipid metabolism. Twenty years later my interests began to migrate towards discovering the extent to which blood levels of omega-3 fatty acids can be viewed as risk factors for disease, much like cholesterol and blood pressure are risk factors for CVD, a low omega-3 level is too. With the invention of the Omega-3 Index (RBC EPA+DHA) in 2004 we began to publish studies link a low Omega-3 Index to not only increased CVD risk but also risk for dementia, for diabetes, for depression, and ultimately for premature death. As a nutritionally-modifiable risk factor, the Omega-3 Index should be incorporated into clinical practice to guide medical care so as to reduce risk for many chronic diseases. This talk will review the effects of omega-3 fatty acids on human lipid metabolism (primarily triglyceride lowering) and on risk for CVD events from randomized trials, and it will also cover the associations between a low Omega-3 Index and risk for multiple human diseases.

Conflict of Interest Disclosure: WSH holds an interest in OmegaQuant Analytics, LLC a clinical laboratory that offers blood fatty acid testing to researchers, health care providers and consumers.

Keywords: omega-3 fatty acids, eicosapentaenoic acid, docosahexaenoic acid, omega-3 index, epidemiology

SY(T7)10-02

Hypertrglyceridemia and low LDL cholesterol

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Under the condition of serum low LDLc with high triglyceride levels:

•Little single genetic background supports low LDLc and high TG, suggesting multiple genetic/non-genetic factors may play roles simultaneously.

•LDLc becomes less powerful predictive value for CVD risk under low LDLc / high TG levels.

•Calculated LDLc levels underestimate LDL particle burden when TG level becomes higher.

•High TG and low LDLc implies TRL-dominant condition and non-HDLc level is largely affected by TG (TRL-associated cholesterol), not LDLc.

•Same nonHDLc level, but with higher TG suggests more burden of atherogenic lipid particles. •Under the condition of low LDL/high TG, LDL particle may become heterogenous dominant with small dense LDL.

•Calculating nonHDLc and measuring apoB may be more informative for the ASCVD prevention.

•LDLc is mostly determined by LDLR-mediated clearance while TG level is determined by multiple metabolic steps from synthesis, lysis and clearance. The prolonged residual time of TRL particles may cause atherosclerotic change of arteries.

Keywords: LDL cholesterol, Triglyceride

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T7)10-03

Postprandial hypertriglyceridemia as a risk factor of atherosclerosis

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Accumulating clinical studies revealed that postprandial hypertriglyceridemia is associated with atherosclerosis, and several clinical guidelines determine the diagnostic criteria for both fating and non-fasting hypertriglyceridemia. The nature of these is elevated levels of triglyceride-rich lipoproteins, especially remnants. This session will discuss the characteristics of remnants and the mechanism of their atherogenesis, and therapy for postprandial hypertriglyceridemia.

Keywords: Postprandial hypertriglyceridemia, atherosclerosis, remnants

SY(T7)10-04

HDL functionalities and life-style modification

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Regarding the prevention of atherosclerotic cardiovascular diseases (ASCVD), epidemiological and observational studies have shown that the lower the blood level of low-density lipoprotein cholesterol (LDL-C), the better. Intervention studies have also shown that this is also true for the LDL-C level. Since low high-density lipoprotein cholesterol (HDL-C) levels have been reported to be a risk for ASCVD, it has been considered logical to increase HDL-C levels with the goal of counteracting residual risk after LDL-C lowering therapy. However, higher blood levels of HDL-C are not necessarily better, and in patients already receiving LDL-C-lowering therapy, increasing HDL-C levels by treatment did not have a preventive effect against ASCVD. Therefore, HDL research has undergone a paradigm shift from "quantity to quality“. With respect to HDL quality, cholesterol efflux capacity has been noted as one of the measurable HDL functionalities. Many investigators, including ourselves, have reported that cholesterol efflux capacity is a more useful surrogate marker of atherosclerosis than HDL-C levels. From the above perspective, it is interesting to study the effects of lifestyle on HDL-C levels and HDL function. This symposium lecture will review studies on the relationship between lifestyle and HDL function that have been reported to date. In addition, I will present our recent report on the effects of genetic polymorphisms of aldehyde dehydrogenase and drinking habits on HDL-C levels and HDL function. I would also like to discuss issues facing HDL function measurement research and the direction of HDL research.

Conflict of Interest Disclosure: Dr. Ogura has received lecture honoraria from Kowa and Amgen.

SY(T7)11-1

The hormetic dose-response mechanism in Nrf2 vitagene system activation and acquired Resilience: Designing new Pharmacotherapeutic Frontiers

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Human life develops and expands not only in time and space, but also in the retrograde permanent recollection and interweaving of memories. Therefore, individual human identity depends fully on a proper access to the autobiographical memory. Such access is hindered or lost under pathological conditions such as Alzheimer's disease (AD), including recently associated oxidant pathologies, such as Parkinson's disease (PD) or neurosensorial degeneration occurring in Menière's disease. Oxidative stress and altered antioxidant systems play a role in the aetiology of major neurodegenerative disorders, and altered expression of genes sensing oxidative stress, as well as decreased cellular stress response mechanisms could synergistically contribute to the course of these oxidant disorders. Mushrooms have been used in traditional medicine for thousands of years [1-2]. In our recent study we evaluated the effects of *Hericium erinaceus*, a nutritional mushroom with important antioxidant effects, in a rat model of AD. *Hericium erinaceus* administration reduced behavioral changes and hippocampal neuronal degeneration. Additionally, it reduced phosphorylated-Tau levels and aberrant APP overexpression and β-amyloid accumulation. Moreover, *Hericium erinaceus* decreased the prooxidative and pro-inflammatory hippocampal alterations induced by AD. In particular, it reduced the activation of the NLRP3 inflammasome components, usually activated by increased oxidative stress during the AD. Collectively, our results showed that *Hericium erinaceus* has protective effects on the behavioral alteration and histological modification associated with the AD acting by the modulation of the oxidative and inflammatory pathways, as well as regulating brain cellular stress. Herein, we discuss cellular mechanisms underlying AD neuroinflammatory pathogenesis that are contributory to Alzheimer's disease. We describe endogenous cellular defence mechanism modulation and neurohormesis as a potentially innovative approach to therapeutics for AD and other neurodegenerative conditions that are associated with mitochondrial dysfunction and neuroinflammation, including Meniere disease patients as a measurable model of

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DOI: 10.1159/000530786

neurodegenerative neuro-cochleosensory system. Particularly, we consider the emerging role of Vitagenes as an important component of the neuroprotective network, as well as the importance of *Coriolus* and *Hericium* nutritional mushrooms in redox stress responsive mechanisms and neuroprotection [2]. In addition, we have explored the development of PD-related pathology in the context of an experimental model of Traumatic brain injury (TBI) and the potential ability of *Coriolus versicolor* and *Hericium erinaceus* to prevent neuro-degenerative processes. A growing number of studies have demonstrated that dietary interventions regulate mitochondrial ROS production, detoxification and oxidative damage repair. Many (but not all) of these nutritional interventions are related with extension of lifespan, or protection against diseases related with age, in mammals. Emerging nutraceuticals are today showing promise as modulators of mitochondrial redox metabolism capable of eliciting beneficial outcomes. Mushrooms, known for their strong antioxidant properties, have attracted interest due to their potential in neuroprotection, antioxidant, and anti-inflammatory effects, as well as in proteome and mitochondrial homeostasis restoration as a basic mechanism to withstand mitochondrial dysfunction-associated neuroinflammatory disorders [1-3].

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Keywords: Hormesis, Nutrition, Antiaging Medicine, Vitagenes, Redox regulation

SY(T7)11-2
Nutritional hormetins, functional foods and hormesis for healthy ageing and longevity

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A detailed understanding of the biological basis of ageing rules out the existence of any specific gerontogenes as the cause of ageing. Genes determine our ability to live and maintain health for a limited period, known as the essential lifespan (ELS), required by nature for the continuation of the species. We are surely able to live much longer than our species' ELS, but our natural survival abilities then need a helping hand for living longer, for maintaining health and for protecting ourselves from diseases in old age. A promising and holistic approach for achieving this is the phenomenon of mild stress-induced hormesis. Physical, nutritional and mental hormetins, which induce hormesis, lead to the stimulation and strengthening of the maintenance and repair systems in cells and tissues. Exercise, heat and irradiation are examples of physical hormetins, which activate heat shock-, DNA repair- and anti-oxidative-stress responses. Several non-nutritional chemical components in functional foods, including flavonoids and polyphenols present in spices, herbs and other sources, are examples of nutritional hormetins, which induce anti-oxidative and anti-inflammatory stress responses. Calorie restriction and intermittent fasting are also hormetins, which activate the autophagic and sirtuin-mediated stress responses. Intense brain activity and focussed attention comprise mental hormetins, which also induce various stress responses. A combination of different hormetins can therefore be the drugs for maintaining, improving and recovering health during ageing.

Conflict of Interest Disclosure: None.
Further Collaborators: x
Keywords: ageing, gerontogenes, stress, health, healthspan

SY(T7)11-3
Novel mechanisms underlying bioactivities of phytochemicals *via* hormesis

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Plants biosynthesize phytochemicals as the secondary metabolites for adaptation to environmental stressors, including intense sunlight and invading organisms. Some of these compounds are biologically dormant and stored in the form of inactive glycosides, and then when insect or microbe exposure occurs, those defensive phytochemicals become activated by β-glucosidases, derived from plants or microbes, to produce bioactive metabolites. These phytochemicals exhibit biological effects to protect against environmental stresses *via* specific mechanisms of action that function to counteract them. Thus, a reasonable fundamental question is why and how phytochemicals have beneficial effects on humans. In fact, the mechanisms of action underlying beneficial functions of phytochemicals remain to be fully elucidated. Most of, if not all, phytochemicals are recognized as xenobiotics in animals are known to induce adaptive responses. Essential related mechanisms include expressions of antioxidative and xenobiotic-metabolizing enzymes, and heat shock proteins (HSPs). Thus, hormesis has been recognized to be an adaptive mechanism by which mild stressors can potentiate the protective capacity of the host, while those at excessive levels are harmful or lethal. We have previously reported that zerumbone, a sesquiterpene in *Zingiber zerumbet* Smith, exhibits anti-inflammatory activity through its non-specific binding to biological proteins by targeting their cysteine residues (1,2). This phytochemical was found to induce protein stress and thereby activated heat shock factor1, which is the key transcription factor for up-regulating anti-inflammatory proteins, including HSPs. On the other hand, the hormesis-related early events in lipolysis induced by polyphenols have recently been identified (3,4). Both curcumin and (-)-epigallocatechin-3-gallate were found to markedly decrease the amounts of triglycerides in differentiated Huh7 mouse hepatoma cells. Interestingly, oxidative and protein stresses

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DOI: 10.1159/000530786

induced by those polyphenols were also demonstrated to significantly contribute to their lipolysis effects. Moreover, the key response to lipolysis was identified as a marked decrease in intracellular ATP levels. Meanwhile, pretreatments of RGM1 gastric mucosal epithelial cells with allyl isothiocyanate (AITC), the pungent taste of 'Wasabi', at lower concentrations resulted in a marked increase in resistance to cytotoxicity induced by AITC at a higher one. This phenomenon may resemble the acquisition of tolerance toward spicy foods by daily consumption of such foods, which can be described as 'chemical training' (5). In addition, our preliminary experiments have shown that quercetin, the major flavonoid in onions, and its metabolites were detected for the first time in the breast milk of quercetin-fed mother mice. Interestingly, they were also found in the blood and urine of newborn mice, suggesting that breast milk-derived quercetin may exert 'chemical training' effects in newborn mice. Taken together, phytochemicals may partially exhibit their bioactivities through hormesis-related mechanisms, and this hypothesis may be supported by the fact that they often show side-effects when given at high doses. References: (1) Ohnishi K, et al. PLoS One. 2013;8:e58641. (2) Igarashi Y, et al. PLoS One. 2016;11:e0161282. (3) Valentine C, et al. J Clin Biochem Nutr. 2019;65:91-98. (4) Suihara S, et al. Biosci Biotechnol Biochem. 2021;85:411-420. (5) Murakami A, Curr Opin Toxicol, in press.

Keywords: Polyphenol, Hormesis, Lipolysis, Stress, Catechin

SY(T7)11-4
Hormetic response to B-type procyanidin Ingestion may involve stress-related neuromodulation via the gut–brain axis: preclinical and clinical observations.

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B-type procyanidins, a series of catechin oligomers, are among the most ingested polyphenols in the human diet. Results of a recent large-scale intervention study have suggested that intake of B-type procyanidins reduces cardiovascular disease risk. Another novel focus has been on the effects of B-type procyanidins on central nervous system (CNS) function. Although long-term B-type procyanidin ingestion is linked to health benefits, a single oral intake has been reported to cause physiological alterations in circulation, metabolism, and the CNS. Comprehensive analyses of previous reports indicate an optimal mid-range dose for the hemodynamic effects of B-type procyanidins, with null responses at lower or higher doses, suggesting hormesis. Findings also indicate that other physiological responses to oral administration of B-type procyanidin follow a hormetic pattern. Indeed, polyphenols, including B-type procyanidins, elicit hormetic responses in vitro, but animal and clinical studies are limited. Hormesis of hemodynamic and metabolic responses to B-type procyanidins was recently confirmed in animal studies, however, and our work has linked these effects to the CNS. Here, we evaluate the hormetic response elicited by B-type procyanidins, recontextualizing the results of intervention trials. In addition, we discuss the possibility that this hormetic response to B-type procyanidins arises via CNS neurotransmitter receptors. We will verify the direction of future research for B-type procyanidins in this lecture.

Keywords: B-type procyanidin, hormesis, sympathetic nervous system, central nervous system.

SY(T8)1-1
Urban allotment gardening and its impact on human health and wellbeing

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The promotion of healthy lifestyles in urban areas is a major challenge for the domain of public health. Urban allotment gardens can offer immense potential as an inexpensive intervention that can help address numerous health-related difficulties confronting metropolitan areas. However, quantitative evidence remains scarce. This paper will present the results of the two studies conducted recently by the author's research group. The first study involved the administration of a questionnaire survey to 332 people in Tokyo to quantify the effects of participation in allotment gardening on their physical, psychological, and social health. The results of the questionnaire survey were utilized to compare five health outcomes self-reported by allotment gardeners (respondents who used allotments) and non-gardener controls (participants who did not use allotments). These five consequences were perceived general health, subjective health complaints, body mass index (BMI), mental health, and social cohesion. Accounting for socio-demographic and lifestyle variables, the regression models revealed that allotment gardeners reported significantly superior perceived general health, lesser subjective health complaints, better mental health, and more social cohesion than non-gardeners. No significant difference was found in the average BMI of gardeners and non-gardeners. These results suggest that regular gardening in urban allotment sites improves the physical, psychological, and social health of city residents. The second study accomplished by the author's group attempted to confirm the generality of the findings of the first study. To this end, it executed a systematic review and meta-analysis of research assessing the effects of gardening, including urban allotment cultivation, on human health and wellbeing. An extensive literature search was performed to accumulate empirical studies comparing health outcomes in a control cohort (non-gardeners or pre-gardening experience reporting) and a treatment group (gardeners or post-gardening experience reporting). The mean difference of health outcomes between the two groups was calculated for each study, and the weighted

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DOI: 10.1159/000530786

effect size was then determined for both investigations across samples and for the sets of subgroup studies. The systematic review identified 22 case studies (76 comparisons between the control and treatment groups) relevant for the meta-analysis. The case studies demonstrated a wide range of health outcomes including the alleviation of depression, reduction of BMI, and the enhancement of life satisfaction, quality of life, and social cohesion. Meta-analytic estimates demonstrated significant positive effects of gardening on the health outcomes for the full participant group as well as the sets of subgroup studies but the effect sizes differed for eight subgroups. These results robustly evidence the beneficial effects of gardening on health and support the findings of the first study. Chronic and non-communicable diseases are becoming more prevalent at an unprecedented pace worldwide. The results presented here are of great consequence for healthcare policy in such a context. They suggest that participation in allotment gardening in urban areas can potentially ensure improved and healthy lifestyles and can help prevent or alleviate health-related risk factors. It is thus recommended that policy-makers and health practitioners should recognize allotment gardening as an important health promotion tool and should encourage people to participate in it.

Keywords: Public health, Urbanization

SY(T8)1-2
The Japanese preference for collaborations between citizen's farms and food-support organizations

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The proportion of low-income households has increased in recent years, in tandem with a rise in social disparities. The relative poverty rate in Japan was worse than the OECD average. Food banks collecting items that are still edible and offering them to low-income households can help resolve the problems of both food-waste and poverty. However, it has been indicated that the supply of vegetables remains insufficient because dry foods are primarily offered to households. This study contemplated a future system of offering vegetables from citizens' farms to low-income households through food-support organizations such as food banks and children's cafeterias.

Three aspects were investigated to evaluate the possibility of the system: 1) the food-support organization's intention to receive vegetables from citizen's farms, 2) the preferences of people to use the land as citizen's farms in collaboration with food-support organizations, and 3) intentions of using citizen's farms in collaboration with food-support organizations.

The first point was addressed via a questionnaire survey conducted in December 2019 for food banks and children's cafeterias throughout Japan. Responses were received from 38 food-bank groups and 94 children's cafeterias. Nearly 90% of children's cafeterias responded positively to collaborations with citizens' farms; however, food banks without any experience in handling vegetables were reluctant to cooperate. The issue of past experience exerted a significant effect on the intention and possibility of food banks receiving vegetables from citizens' farms. Concerns about when the vegetables would be served and the quality and types of vegetables had a significant influence on the perceived ability of food banks to receive vegetables.

Conjoint analysis was performed using four types of land use to investigate preferences apropos different land-use patterns: a) citizens' farms without collaborations with food-support organizations, b) citizens' farms with such collaborations, c) parks, and d) open spaces for disaster prevention. An online survey was conducted throughout Japan in August 2021, and gained 11,520 respondents. The results revealed the highest preference for open spaces for disaster prevention. People who knew about citizens' farms, who had experienced vegetable gardening, and who had a higher emotional affinity toward nature showed a stronger preference for citizens' farms with collaborations with food-support organizations.

Evaluation of the actual intention to use farms was probed through an online questionnaire survey with respondents who had shown positive preferences for citizens' farms with or without collaborations with food-support organizations in the previous survey. Respondents living in four prefectures (Tokyo, Saitama, Kanagawa, and Chiba) in the Kanto area were targeted (n = 4,720) and the survey was conducted in December 2021. The results elucidated that around 30% of the respondents would like to use citizens' farms with or without collaborations with food-support organizations. However, only one-third of this 30% were willing to pay a usage fee. The fee of 2,510 JPY/month (21.8 US$/month) was asserted as acceptable and this value remained the same for citizens' farms with or without collaborations with food-support organizations.

Keywords: Citizen's preference, urban allotment, conjoint analysis, food-support organization.

SY(T8)1-3
Linkages between dietary diversity of farmers and agriculture in West Java, Indonesia

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Dietary diversity is a key concept for balanced nutritional intake and this theory has attracted attention as a complementary indicator vis-à-vis individual energy and nutrient (protein, vitamins, etc.) intake. Dietary diversity can be measured more easily than individual nutrient intake using formatted questionnaires. This is expected to contribute to the development of nutrition improvement programs, especially in

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DOI: 10.1159/000530786

developing countries. It is important to understand the socio-economic drivers that increase dietary diversity to utilize dietary diversity in nutrition improvement programs. However, the number of existing studies is adequately substantive for the comprehension of distinctions in diverse food and agriculture systems around the world. In particular, knowledge is lacking apropos the drivers of dietary diversity in areas where commercial agriculture has developed. Previous studies have indicated two main factors influencing dietary diversity: production variety and market access. Production variety refers to the multiplicity of crops produced by a household or individual in a given period. Several studies have demonstrated that higher production variety is associated with higher dietary diversity, but numerous other studies have not confirmed this relationship. The connection between production and dietary diversity may be explained by the significance of subsistence agriculture and the effects of production diversity on the economic stability of households. Market access is often described by distance to food markets as a proxy variable, but the relationship between dietary diversity and the varied non-farming roles of farm households has not been fully explored. Both production variety and market access could strongly influence dietary diversity in areas dominated by commercial agriculture. A dietary and agricultural survey was conducted in 2019 in a village in Bandung, West Java, in Indonesia. Environmental and health concerns have resulted in the introduction of coffee agroforestry, a new type of commercial agriculture in this region that offers an alternative livelihood in comparison to traditional commercial agriculture of intensive vegetable production. The survey results evidenced associations between dietary diversity, production variety, and market access observed in the study area. The nutritional implications of these relationships in a commercial agricultural area are also discussed in the study. This presentation will also deliberate on the potential development of measurement methods of these key indicators of links between food and agriculture.

Keywords: dietary diversity, production variety, market access, agroforestry.

SY(T8)1-4
Nutrient deficiency in children in the deforested front of Cambodia in relation to different food sources

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Deforestation is a driver of biodiversity loss and climate change. Macroscopic analyses have suggested that it could also cause vital consequences for human nutrition, including the nourishment of children. A study was initiated in Cambodia by the author's group. The forests in this region are disappearing at the fastest rate in Southeast Asia. The study examined the nutritional status of the children living in forested areas and probed the roles discharged by discrete food sources: edible items that were purchased, self-produced, wild, and shared by neighbors. The weights and heights of 161 children aged 5–10 years and residing within and around the Prey Lang Wildlife Sanctuary in Stung Treng Province of Cambodia were measured in February 2020. Their food intake (24-hour recall) and the source of each food item were also surveyed. Stunting (HAZ ≦ -2), underweight (WAZ ≦ -2), and acute malnutrition (BMI-Z ≦ -2) were observed in one-fourth, one-fourth, and one-tenth of the children, respectively. Intake was insufficient for many nutrients, except for sodium and vitamin C. Serious deficiencies were observed for zinc, copper, potassium, calcium, vitamin A, and vitamin B1 (thiamin). More than half of the children did not even reach 50 % of the Recommended Dietary Allowance for these nutrients (RDA). The sufficiency of nutrients ingested by each child (NT) was also assessed by counting the number of nutrients (maximum 14) for which the RDA of the corresponding age and sex was satisfied. The observed minimum, maximum, and mean NT of the children were 0, 13, and 3.66, respectively. When the purchased food was removed from the calculation, the mean NT dropped to 0.56, and most children could not meet the RDA for all nutrients, except for vitamin C, which could be acquired from locally grown fruits. The impact of removing self-produced food was not as substantial as the elimination of purchased food, but there was also a moderate drop in mean NT = 2.62 and RDA sufficiency in energy, protein, dietary fiber, phosphorus, iron, and vitamin C. There was little change in mean NT and the overall pattern of nutrient sufficiency (3.53 and 3.43, respectively) when wild food (those from forest, fallow, stream, etc.) and shared provisions were eliminated. The preliminary results evinced that purchased food was the most important food source and that it supplied numerous nutrients to the children, followed by self-produced food. The contribution of wild and shared food items was very small in terms of satisfying RDA levels. However, the study results also implied that food supplied from these sources was insufficient to meet the nutrient requirements of many children for most nutrients, except for sodium and vitamin C. Better access to food markets and enhanced provision of nutritious and diverse foods from the local agricultural system would be crucial aspects of consideration in planning livelihood support programs in the region. Attention must also be paid to the potential structural shortcomings of the local food system in which some vitamins and minerals (especially zinc, copper, and potassium) and vitamins appear difficult to access.

Keywords: Nutrient Deficiency, Micronutrients, Purchased food, Self-produced food, Deforestation

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DOI: 10.1159/000530786

SY(T8)2-1
Small-scale fisheries and aquaculture that contribute to the local needs on human nutrition in developing countries

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Fish and fishery products play a vital role for food and nutrition security by providing food and income. Fish is an 'irreplaceable' animal-source food (ASF) in many Asian and African countries where large numbers of people are undernourished and poor. Fish and other aquatic animals are rich sources of a wide range of micronutrients, essential fatty acids and animal protein that are crucial for human brain development and cognition. Fish is the most commonly and frequently eaten, cheapest ASF in many low-income food deficit countries where the diet is mainly dominated by starchy staples and plant-source foods. Adding small amounts of fish to the plant-based diet can significantly improve diet quality.

At the same time, fish has always been treated as a commodity. It generates monetary income for family fisher-folks, as well as foreign money for the developing countries. According to the data by Food and Agriculture Organization of the United Nations (FAO), approximately 37.6% of fish are exported. This percentage is higher if compared with other agricultural products. As for rice, only 9.1% are exported. This suggests that rice is produced mostly for the purpose of domestic consumptions, whereas fish are farmed or caught targeting at export markets.

Pros and cons for the export operations need to be assessed carefully. Demand for fish has increased in recent years, both in developed and developing countries with the growing global population. New rich sectors in cities increase their consumption of animal protein. On the other hand, in some rural areas few fishers and fish farmers can consume the commodity they catch or grow; instead, they sell the majority of their catch to earn money to meet other necessities. In the same local areas, commercial fish buyers have market powers and lend money to artisanal fishers. In return, the buyers obtain fish at lower price from the money borrowers. A shift of fisheries from subsistence to export oriented ones could result in inequity and malnutrition. Maintaining equitable society as well as well healthy ecosystems that allow sustainable supplies and consumption of fish and fisheries products are crucial for the health and wellbeing of people.

Keywords: small-scale fishery, export, nutrition, SDGs
Conflict of Interest Disclosure: None
Further Collaborators: Rumana Akter

SY(T8)2-2
JICA's support for the fisheries and aquaculture sector and its contributions to food and nutrition security in developing countries

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JICA has been working with developing countries for the development of fisheries and aquaculture sector in a various context. Although our activities are not always designed to directly address the nutrition issues, it is observed that there is a certain effect on food and nutrition security since our strength is to reach out to the rural areas where economically vulnerable people reside and malnutrition is prevalent. The contributions of JICA's efforts in fisheries and aquaculture development in addressing nutrition issues can be found in the following aspects. 1) Ensuring sustainable supply of aquatic foods: fisheries resources are often under threat of over-exploitation and aquatic food supply could be seriously diminished if due efforts are not made for resource management, 2) Increasing localized production of aquatic food; fish farming has the potential to feed the people in need in rural areas, 3) Increasing complementarity with agricultural production; in drought prone areas, subsistence production of famed fish play a role in supplying nutritious food in food deficit dry periods, 4) Reducing vulnerability to acute food insecurity; when local communities are devastated by natural disasters such as drought or cyclones, locally managed water areas can serve as the food bank for the people. In this connection, some reports from field activities in Eritrea, Ethiopia, Mozambique, Benin, Guinea, and Vanuatu are introduced. Our challenge remains, however, with how to ensure nutrition sensitive approach in such development efforts. The above-mentioned activities are aimed at other objectives such as resource management and promotion of aquaculture, and hence there is a limitation in increasing the positive effect on nutrition improvement of target population. New opportunities exist with the Initiative for Food and Nutrition in Africa (IFNA), which is a joint initiative led by African Union Development Agency New Partnership for Africa's Development and JCA. The IFNA sees the importance of non-staple food production such as fish and it is envisaged that nutrition sensitive approach in JICA's projects will be strengthened in the framework of IFNA.

Keywords: IFNA, Nutrition, Fisheries, Aquaculture

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DOI: 10.1159/000530786

SY(T8)2-3
Transforming food systems with aquatic foods for healthier people and planet

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In just the last few years, there have been a number of global initiatives in which aquatic food systems have been integrated. These include the UN Food Systems Summit 2021, termed the people's summit, and COP 26. The Scientific Group for the UN Food Systems Summit 2021 provided seven priorities for transforming food systems to end hunger and protect our planet; one being: “sustain aquatic foods”. At COP 26, following on the UN Food Systems Summit 2021, calls for transformation of food, land and water systems for nourishing people as well as our planet were made. Aquatic food systems were recognized and acknowledged for their importance in enabling climate mitigation measures. Aquatic foods, in particular, seaweed and low trophic animals featured prominently in discussions on nature-based solutions for addressing the challenges of climate crises. At the same time, aquatic foods; the diverse and very many animals, plants and microorganisms found in marine and inland waters are considered superfoods; bountiful in multiple nutrients; including minerals, vitamins, and essential fatty acids. These nutrients are crucial for cognition, development and growth in young children as well as nutrition and health in adults. As aquatic foods are consumed by over three billion people and provide livelihood opportunities for over 800 million people, globally, it is imperative that we advocate for food and nutrition policies, investments and interventions that include aquatic foods for nourishing nations.

Keywords: Aquatic foods, Food systems, Nourishing nations

SY(T8)2-4
Contribution of fish to the diets of low-income households

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The State of Food Security and Nutrition in the World 2021 report estimated that 3 billion people were not able to afford a healthy diet. Poor diet remains a major cause of disease and severely impacts economic development. Animal source food (ASF) accounts for 36% of the total cost of healthy diets. In many Sub-Saharan African countries, fish represents an affordable source of animal protein that is culturally acceptable. Under the auspices of the *Enhancing Nutrition through Animal Source Food Management* (*ENAM*) project, we undertook a study to improve Ghanaian children's ASF intake. We assessed the contribution of fish to household diets in three agro-ecological regions. Using food frequency data, we analyzed the frequency of consumption of different types of ASF by household food insecurity status. Consumption of poultry, eggs, dairy, and red meat in the past week was significantly more frequent among feed secure/mildly food insecure households compared moderate/severe food insecure households However, there was no difference in the frequency of fish consumption by household insecurity status. Almost all households (>98%) reported fish consumption in the past week. In all, 15 different species of fish were identified from household diets. We conclude that fish is the most accessible ASF for low-income households in this study population. With its high accessibility, there is need to assure that it is reaching all vulnerable members of households in adequate amounts.

Keywords: Fish, Diet, Low income, Ghana

SY(T8)2-5
Fishing for Complements: How Aquaculture Helps Improve Diet Quality among the Poor

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Interest in 'blue food' systems has grown in recent years. A focus on aquatic foods (fish, shellfish, algae, etc.) is underpinned by recognition that diets around the world would be enhanced by inclusion of water-based production, and that blue food systems can be nature-positive complements to terrestrial farming. This paper focuses on the contributions to, and benefits from, aquatic foods to livelihoods and diets of poor households in resource constrained settings.

Conflict of Interest Disclosure: None

Keywords: Nutrition, Diets, Aquaculture, Fisheries, Poverty

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T8)2-6

Dimensions of the Food Environment to consider when promoting fish and other aquatic foods in low- and middle-income countries

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Introduction: Fish and other aquatic foods are nutritious and healthy food choices that can also be sustainable. The nutrient density of fish and aquatic foods (especially seaweed, small fish and bivalves), surpass that of staple grains and tubers, fruits and vegetables. Small fish species, in particular, are rich in calcium, iron, zinc, vitamin A and vitamin B12. Several dimensions of the food environment, or the space where consumers procure food, influence consumer choice and are important to consider when promoting fish and other aquatic foods.

Methods: We use a food environment lens to review availability, affordability, desirability, convenience and sustainability of aquatic foods and consider opportunities and barriers to promote fish and other aquatic foods for sustainable, healthy diets.

Results and Discussion: *Availability*: Over 3,000 species of fish, crustaceans, molluscs, aquatic plants and aquatic animals are used for food. The global per capita consumption of fish has been steadily increasing over the past three decades, in large part due to increasing contribution of aquaculture. However, there is a concerning downward trend in consumption predicted in sub-Saharan Africa. Reducing loss and waste, estimated at approximately 35% is urgently needed. There are positive examples of improvements gained in LMICs through simple and low-cost investments in technologies such as raised rack drying, reducing contact with insects and improvements in sanitation and hygiene practices at retail level. *Affordability*: To respond to malnutrition in all its forms, affordability must include nutrient density and not only price per quantity. Recent studies on the affordability of fish and other aquatic foods compared to other major food groups, are mixed. In grouping fish and other aquatic foods from marine waters all together, the price per unit quantity relative to other foods, especially cereals and oils is high. However, when foods are ranked by cost/nutrient density, the affordability of fresh fish was ranked next to that of eggs and milk in Asia. Additionally, the price of small fish species is lower than that of large species. *Desirability and Convenience*: Food safety is a concern among consumers and fish are very susceptible to spoilage and contamination. Innovations that make nutrient-dense fish and aquatic products ready to use and safe are important to consumers. In the USAID NOURISH project in Cambodia; small fish species were processed into a ready-to-use fish powder that was widely accepted and created employment for women-owned businesses. *Sustainability*: The USAID Fish Innovation Lab project *Samaki Salama* in coastal Kenya tested an integrated intervention in small fisher households through sustainable fisheries production to increase availability and access and social marketing to encourage families to give fish to young children.

Conclusions: A vast array of aquatic foods can ensure nutrition security and offer consumers healthy, sustainable dietary choices. Adopting low-cost, proven strategies to reduce loss and improve food safety, and employing innovations in sustainable fisheries, food processing and social marketing can help to increase the nutritional benefits of fish and other aquatic foods towards the transformation of food systems to nourish people.

Conflict of Interest Disclosure: None

Keywords: Fish and other aquatic foods, Food Environment, Diet, Availability, Affordability

SY(T8)2-7

Household engagement with aquaculture-horticulture is associated with better diet quality

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Background: Multiple micronutrient deficiencies are highly prevalent among in Bangladesh. Common micronutrient deficiencies reported in Bangladesh are vitamin A, iron, calcium, folic acid, zinc, vitamin B12, and iodine.

Objectives

The study assessed diet quality of households by their types of engagement with homestead aquaculture and/or horticulture production or none. Socio-demographic determinants of diet quality were also studied.

Methods: Data for this paper were sourced from the "Bangladesh Aquaculture-Horticulture for Nutrition Research" study conducted by the Feed the Future Innovation Lab for Nutrition, collected between January and April 2016. Diet quality was assessed using a nutrient adequacy ratio (NAR), based on the preceding 7 days' dietary recall of the household. Adult male equivalent units (AMEs) were calculated for age- and sex-specific intra-household distribution of household intakes. Mean adequacy ratios (MAR) were computed as an overall measure of diet quality, using NAR. In addition to energy, the study assessed dietary intake of total eleven micronutrients: iron, calcium, zinc, vitamin A, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, and vitamin C.

Results: Better diet quality (mean±SD) was associated with households engaged in both homestead aquaculture and horticulture (0.43±0.23; p <0.001) compared to only one type of agriculture (0.38±0.20) or none (0.36 ±0.20). Tukey's post-hoc test confirmed significant differences in diet quality between both and either engagement (0.05±0.01, p < 0.001), both and no engagement (0.07±0.01, p < 0.001), and either and no engagement households (0.02±0.01, p <0.001). Recommended

dietary micronutrients and energy intake were significantly and positively associated ($p < 0.01$) with households engaged in both types compared to either or no type of engagement, except for vitamin B6 and vitamin C ($p < 0.05$). Quantity of fish and seafoods, vegetables, fruits, legumes/nuts/seeds, and staple food intakes were significantly higher (278.8 g/person/d; 88.9 g/person/d; 69.0 g/person/d; 14.7 g/person/d; and 395.4 g/person/d respectively; $p < 0.001$) in households engaged in both aquaculture and horticulture compared to either or none. Sources of fish and seafood and vegetables consumed by the households in both/either engagement were mostly from households' own production. Generalized estimating equations showed that diet quality was influenced by the higher educational level and occupation of adult household members, higher daily per capita food expenditure, sex, family size and region.

Conclusion: Household engagement in both homestead aquaculture and horticulture have the potential to improve diet quality of households.

Keywords: diet quality, aquaculture, horticulture, dietary micronutrients

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

SY(T8)3-1
1-Deoxysphingolipids and their analogs in foods: the occurrence and potential impact on human health

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Typical sphingolipids are comprised of sphingoid bases, such as sphinganine and sphingosine, these are produced via the condensation of L-serine with a fatty acyl-CoA by serine palmitoyltransferase. Many organisms, including mammals, produce “atypical” sphingolipids that are synthesized *de novo* with alanine as 1-deoxysphingoid bases, that can be synthesized as 1-deoxyceramides by *N*-acylation. The biological functions of 1-deoxysphingolipids are still not well understood but are noticeable in neuropathies, diabetes, non-alcoholic steatohepatitis, and other metabolic diseases[1]. Considerable variability in the amounts and molecular subspecies of atypical sphingoid bases and their *N*-acyl metabolites have been found in meats and seafoods, espically in squid and octopus[2]. More than this, we recently discovered a group of “1-deoxyceramide mimic” metabolites of a 1-deoxysphingaine analog: fusarium toxin 2-amino-14,16-dimethyloctadecan-3-ol (2-AOD-3-ol) from *Fusarium avenaceum*-infected crops and fruits. 2-AOD-3-ol was predominantly present as a C16:1 fatty acid-assembled form rather than as the free amine. Although 2-AOD-3-ol and its fatty acyl derivatives were barely detected in fresh samples, the contents of these fusarium toxins accumulated with the extension of food storage up to approximately 32-50 mg/kg dry weight in naturally stored rice, grapes, apples, and oranges[3]. The amounts of the 1-deoxysphingolipids are lower than typical sphingolipids in foods analyzed thus far, but their relative efficacy might be comparable or even greater because 1-deoxysphingoid bases can be readily absorbed but not can be phosphorylated and degraded in intestinal cells[4]. A broader assessment of the dietary sphingolipids is needed because food materials might contain sufficient amounts of atypical sphingolipids that could have beneficial or possibly deleterious effects on human health.

Keywords: 1-deoxysphingolipids, dietary sphingolipids

SY(T8)3-2
Structure and function of fucosylated chondroitin sulfate from sea cucumber

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Sea cucumber polysaccharide is a highly sulfated marine polysaccharide, and its titer is much higher than that of plant polysaccharide. However, sea cucumber polysaccharide has low mass spectrum and nuclear magnetic response, difficult structure identification, and the sulfuric acid structure is easy to be destroyed during degradation, which leads to the unclear structure-activity mechanism of sea cucumber polysaccharide and limits its deep development. Therefore, it is urgent to analyze the structure of sea cucumber polysaccharide and develop accurate structure-activity products.

In our study, online hydrophilic interaction chromatography–Fourier transform mass spectrometry (FTMS) was applied to analyze the fucosylated chondroitin sulfates (FCS) oligosaccharides. These depolymerized FCS fragments were quantified and compared using the glycomics software package, GlycReSoft. The quantified fragments mainly had trisaccharide-repeating compositions and showed significant differences in fucosylation (including its sulfation) among different species of sea cucumbers. Detailed analysis of FTMS ion peaks and top-down nuclear magnetic resonance spectroscopy of native FCS polysaccharides verified the accuracy of this method. This bottom-up approach provides rich detailed structural analysis and provides quantitative information with high accuracy and reproducibility and should be suitable for the quality control in FCSs as well as their oligosaccharides. We then prepared highly purified FCS trisaccharide repeating units from hexasaccharide (6-mer) to octadecasaccharide (18-mer), including those with 2,4-disulfated and 3,4-disulfated Fuc branches. In vitro anticoagulant activities and surface plasmon resonance binding tests indicated those of larger molecular sizes and 2,4-disulfated Fuc branches showed stronger anticoagulant effects with respect to anti-FXase activity, as well as stronger binding to FIXa among various clotting proteins. All FCS 9–18 oligomers also resulted in no bleeding, hypotension, or platelet aggregation risk during blood circulation. Thus, FCS 9–18 oligomers with 2,4-disulfated or 3,4-disulfated Fuc branches exhibit potent and safe antithrombotic activity needed for clinical applications.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: chondroitin sulfates, structure analyze, antithrombotic activity

SY(T8)3-3
Dietary fish protein improves skeletal muscle weight

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Epidemiological studies have long reported that fish consumption contributes to health, however, there is little knowledge about the function of fish protein. We have focused on Alaska pollack protein (APP), which is widely used such as Kamaboko and fish sausage, and have searched for health-promoting function. In these studies, we found that dietary APP increases skeletal muscle mass in rats compared to a casein diet feeding, even though there was no exercise load. Although we have first found the increasing effect of dietary APP on skeletal muscle in high-fat diet feeding for 4 to 8 weeks, in subsequent studies, we found that dietary APP increases skeletal muscle mass both male and female, even in a very short period of 2 to 7 days, regardless of whether in a high-fat or a normal diet feeding. We also found that dietary APP increased rat skeletal muscle weight in the recovery period after immobilization. In these experiments, the administration of APP is performed by feeding AIN-93 diets in which all the protein sources are substituted casein with APP. As a result of the dose response study, the skeletal muscle weights in the rats fed diets in which more than one-third protein source were substituted APP for casein were significantly increased. The amino acids mixture powder similar to the amino acids composition of APP did not affect skeletal muscle mass. The characteristics of the amino acid composition might not contribute to the mechanism. Dietary APP increased the cross-sectional area of the gastrocnemius skeletal muscle and collagen-rich connective tissue. In order to investigate the mechanism of action, we measured the gene expression of factors involved in skeletal muscle formation and muscle protein synthesis and degradation. Dietary APP decreased gene expression of muscle-specific ubiquitin ligase (atrogen-1, MuRF1) and myostatin, suggesting that the synthesis of muscle protein was promoted and the decomposition was suppressed by dietary APP. A comparative and chronological analysis using cDNA microarrays revealed that dietary APP leads to a similar series of changes in gene expression to those for inhibition of muscle protein degradation and subsequent muscle regeneration after exercise-induced muscle injury. Furthermore, comprehensive proteomic analyses were conducted and the pathway analyses indicated that the activity of the growth factor signaling pathway was significantly impacted by dietary APP. Moreover, APP could promote protein synthesis by activating the protein kinase B/mechanistic target of the rapamycin signaling pathway, which is also promoted by exercise. Several clinical trials have already been conducted to examine the effect of increasing muscle mass by ingesting APP. In a study investigating the effect of APP ingestion on training-induced neural and muscular adaptations in older adults, significant increases in lower extremity muscle mass and muscle strength from 0 to 8 weeks were demonstrated only for APP. And in a study investigating the effect of APP ingestion on no training-induced neural and muscular adaptations in older adult women, daily APP intake can increase skeletal muscle mass and lower-extremity muscle strength in healthy older women from 12-24 weeks more than whey protein intake.

Keywords: Fish protein, Alaska pollack, skeletal muscle.

Conflict of Interest Disclosure: F.K. and K.H. are former employees of Nippon Suisan Kaisha Ltd., and K.U. is a current employee of Nippon Suisan Kaisha Ltd. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

SY(T8)3-4
Nutraceutical potential of siphonaxanthin, a green algal carotenoid

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Marine algae are a potential renewable resource in the marine environment and an excellent source of nutritional and bioactive compounds such as carotenoids, dietary fiber, amino acids, essential fatty acids, vitamins, and minerals, which contribute to several beneficial effects in human health. Algal carotenoids are of particular interest because they are structurally and functionally different from those found in land plants. We have focused on the utilization of functional food components in unutilized biological resources and food processing residues, and have found that siphonaxanthin has various biological activities such as anti-angiogenic, anti-obesity, and anti-inflammatory effects more potent than other carotenoids. Siphonaxanthin is a specific keto-carotenoid of siphonaceous green algae, which helps in absorbing available green and blue green light under water. In edible green algae such as *Codium fragile*, *Caulerpa lentillifera*, and *Umbraulva japonica*, siphonaxanthin content is approximately 0.03%–0.1% of the dry weight.

We have previously demonstrated that siphonaxanthin potently suppresses the viability of human leukemia HL-60 cells via induction of apoptosis (*Biochim. Biophys. Acta* 1810: 497-503, 2011) and possesses significant anti-angiogenic activity via down-regulation of signal transduction by fibroblast growth

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

factor receptor-1 in vascular endothelial cells (*Phytomed*. 17: 1140-1144, 2010; *Mol. Cell. Biochem*. 380: 1-9, 2013). On the other hand, dietary siphonaxanthin shows the anti-obesity and protective effects against lipotoxicity (*J. Nutr*. 145: 490-498, 2015; *Lipids* 53: 41-52, 2018; *Nutr*. *Res.*77: 29-42, 2020). Siphonaxanthin also exhibits the unique anti-inflammatory properties (*J. Oleo Sci.* 63: 291-294, 2014; *J.Nat . Med*. 74: 127-134, 2020; *Nutrients* 13: 3699, 2021). Interestingly, siphonaxanthin supplementation can prevent skin photoaging such as wrinkling and skin barrier disruption in UVA-irradiated mice. In this case, detectable amounts of siphonaxanthin and its metabolites were accumulated in the dermis and epidermis. We also have evaluated the mechanism of intestinal absorption and metabolic fate of dietary siphonaxanthin (*Lipids*.54: 707-714, 2019; *Mar*. *Drugs* 18: 291, 2020.).

Our results indicate that siphonaxanthin has strong potential as a nutraceutical candidate among marine carotenoids. Our novel findings open up new avenues for future research on the advanced utilization of siphonaxanthin as a bioactive substance.

Keywords: green algae, carotenoid, siphonaxanthin

SY(T8)4-1
Metabolomics as a generic tool to help us understand food quality

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Consumers continue to demand to be able to buy food materials with enhanced product quality and which are obtained from more sustainable production systems. Most crops are effectively used as chemical factories with the food crops producing our nutrients and vitamins. But in addition to these basic nutritional requirements, the role of molecules associated with food flavour and fragrance as well as appearance (e.g. colour) should never be underestimated. These are usually the drivers of consumer choice and re-purchasing behaviour. Plant-based foods comprise ca 80% of all food consumed globally. Plants are incredibly successful biochemists with each species producing tens of thousands of metabolites, the synthesis of which is strongly controlled both spatially and temporally. Furthermore, the chemical components in our food are dependent on the influence of both genetic and environmental factors. A final determinant is of course how food materials are processed before reaching the supermarket shelf. Plant metabolomics approaches have been developed and widely applied over the last 15 – 20 years in untargeted strategies to allow us to mine and chart the plant metabolome and determine how both internal and external factors influence the final chemical profile. These technologies now help us gain deeper insights into the extent of the complexity of plant metabolism and reveal the nature of its dynamism. In this talk I shall use a number of examples involving a range of crop species where we have exploited LC-MS and / or GC-MS – based technologies to gain a deeper understanding of how biochemical profiles are linked to aspects of crop phenotype and how these, in turn, relate to final product quality for both fresh and heavily processed foods. Diverse crops have been studied to demonstrate the truly generic nature of the methodology and the potential value of such approaches in an applied context. By exploiting metabolomics data we have become able to design new strategies to improve the biochemical composition of crop materials and how these are best converted into our food products in order to meet better future demands for quality and sustainability.

Keywords: Metabolomics, Plants, Food quality, Flavour, Fragrance.

Conflict of Interest Disclosure: None

SY(T8)4-2
Metabolomics approach for durian orchards towards innovative products

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Durian (*Durio zibethinus* L.) is one of the important economic fruits for many Southeast Asian countries including Thailand. We used metabolomics to dissect chemical compositions in both early immature durian fruit, an agricultural waste from durian orchards, and pulps during postharvest ripening. LC-MS approach leads to identification of polyphenols in the immature fruit that can be exploited as a novel source in many products. Multi-platform metabolomics in durian pulps provided data on metabolic changes during fruit ripening and metabolic variation in different cultivars. These data help us to understand compounds contributed to the flavour of durian and will be useful for breeding program. In addition, we identified several bioactive compounds such as gamma-glutamylcysteine and GABA that can be used as a bioactive marker in dietary supplement products. Therefore, we believed metabolomics is a powerful strategy towards developing innovative products.

Keywords: Bioactive compounds, Durian, Metabolome, Agricultural waste, Fruit ripening

Conflict of Interest Disclosure: None

Further Collaborators: Kazuki Saito, Japan
Akira Oikawa, Japan
Takayuki Tohge, Japan
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SY(T8)4-3
Mass spectrometry based metabolomics for quality improvement of high value food products

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Metabolomics is the study of global quantitative assessment of metabolites in a biological system. Metabolites are the result of the interaction of the system's genome with its environment and are not merely the end product of gene expression but also form part of the regulatory system in an integrated manner. The exhaustive profiling of metabolites is an advantageous feature for analysis of various kinds of organisms including microbes and plants compared to the conventional analysis that only targets specific compounds. Metabolites, target in metabolomics technology, can be directly connected with phenotype that is sensitively affected by any type of perturbation or stress. The capacity of metabolomics to measure metabolites as well as to identify food components favor its usefulness for detection of adulterated crops or food products as well as for food quality improvement. Our group has pioneered the application of metabolomics for quality assessment of various important tropical food and crops. Here, several examples of metabolomics application for discrimination and classification of important food products will be provided. In addition, metabolite profiling for quality improvement of high value food products such as mango, mangosteen, pineapple, banana, shrimp, coffee, cacao, fermented foods will be discussed in this talk.

Keywords: metabolomics, fermented food, tropical fruits, coffee, cacao

Conflict of Interest Disclosure: none

Further Collaborators: Prof. Eiichiro Fukusaki, Osaka University

SY(T8)4-4
Comprehensive analysis of aroma components and metabolites in alcoholic beverages

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Foods and beverages contain numerous organic compounds with various functions and effects. Some have nutritious value, some contribute to the taste and flavor, some maintain its quality, and some are known to promote healthy conditions of those that acquire it. The wide range of physiochemical properties of the components require different analytical techniques to identify and quantify but advances in analytical technology now enables various types of automation, from sample preparation, chromatographic analysis, to sample analysis, providing us with an even higher level of reliable results. This automation eases the use of multivariate analysis for finding trace levels of differences in sample types.

In this study, three types of analysis using different chromatographic instrumentation was done on the 6 different red wine samples. Flavor compounds were analyzed with extraction by SPME (solid phase micro extraction), analysis and simultaneous detection by GC-MS (gas chromatography – mass spectrometry) and GC-SCD (gas chromatography- sulfur chemiluminescence detector) using a capillary splitter. Samples were derivatized and analyzed by GC-MS for metabolite analysis. Water dilutions of samples were analyzed by CE-MS (Capillary Electrophoresis – Mass Spectrometry). A retention time locked metabolomics library was used to identify the metabolomic compounds.

After comparison of 4 different types of SPME fibers for the extraction of flavor compounds, the fiber with the combination of Carboxen and PDMS (polydimethylsiloxane) showed the most sulfur peaks from the SCD results. The largest 14 peaks from the SCD were identified using spectral and RI (retention indices) information. Comparison of total sulfur amount and sulfur compound constitution resulted in a 4-fold difference at most between the wine with the least and most amount of sulfur detected. Mercaptans, sulfides, sulfur dioxide, carbon disulfide, sulfur dioxide, and thio-alcohols were the main sulfur compounds detected. The GC-MS and CE-MS results were taken to multivariate analysis. After filtering the entities by parameters like frequency and variability, PCA (principal component analysis) and clustering showed differences of compounds like furans, esters, acids and their amounts contained. Sensory evaluation results did match with the metabolomic compounds and their difference by wine sample, showing that this procedure can be an efficient was to evaluate samples and their differences.

Such analysis methods handling multiple compounds within multiple samples using multivariate analyses has proven to be a useful tool for finding differences and their factors between samples.

Keywords: GC-MS, GC-SCD, metabolomics, sulfur compounds, red wine

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T8)5-1
Profile of Human Milk Oligosaccharides and Changes over 52 weeks in Healthy Taiwanese Mothers

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Background and objectives: Human milk oligosaccharides (HMO) promote the growth of probiotics. The HMO profiles in milk vary among individuals with genetic backgrounds and maternal diet. The HMO profile data are still limited, especial from Taiwanese mothers. The objective of this study is to investigate the HMO profile changes in Taiwanese mothers over 52 weeks of lactation.

Method: We quantified 17 major HMO and semi-quantified 4 HMO in samples from 89 Taiwanese mothers (n = 39, 24, 44, 24, 37, 41, 23, 5 at week 1, 2.5, 4, 5, 8, 16, 24, 52 postpartum) using porous graphitic carbon liquid chromatography-Orbitrap mass spectrometry.

Results:2'-FL, 3-FL, LNFP II, LNT, and LNFP I accounted for most HMO (>65%). The total HMO concentration significantly decreased (p < 0.05) from 10.87 to 7.09 g/L over 24 weeks postpartum. The concentration of 3-FL increased dramatically from 0.60 to 1.90 g/L (316%), while LNT and LNFP I significantly decreased from 1.31 to 0.51 (39%) and 1.23 to 0.28 g/L (23%), respectively. 2'-FL significantly reduced from 2.48 to 1.22 g/L (49%) over 16 weeks postpartum. HMO with Le^x antigen epitope significantly increased from 15.9 to 38.0% in relative abundance over 24 weeks postpartum. In contrast, the H1 antigen and non-epitope group significantly decreased from 10.3 to 2.8% and 28.3 to 10.1% over 52 weeks postpartum. Furthermore, we observed that the HMO profile changed in those mothers who supplemented with folic acid during pregnancy.

Conclusions: The concentration of total HMO, 2'-FL, LNT, and LNFP I significantly decreased during the lactation period, while 3-FL significantly increased. Folic acid supplements during pregnancy may affect HMO profiles. It is necessary to study further the effects of maternal dietary patterns on HMO profiles.

Keywords: human milk oligosaccharides (HMO), lactation period, profiling analysis, porous graphitic carbon liquid chromatography-Orbitrap mass spectrometry

SY(T8)5-2
Determination of triacylglycerol oxidation mechanisms using liquid chromatography-tandem mass spectrometry

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Triacylglycerol (TG), the main component of edible oil, is oxidized by thermal- (radical) or photo-(singlet oxygen ($^1O_2$) oxidation to form TG hydroperoxide (TGOOH) as the primary oxidation product. Since TGOOH and its subsequent oxidation products cause not only the deterioration of oil quality but also various toxicities, preventing the excessive oxidation of edible oils is essential. Thereby understanding oxidation mechanisms that cause the formation of TGOOH is necessary (e.g. radical oxidation is effectively suppressed by tocopherol). Isomeric information of TGOOH provides insights about oil oxidation mechanisms (i.e., radical- and $^1O_2$-oxidation). We recently observed the hydroperoxide-position specific fragmentations based on cation-π interaction on mass spectrometry (1). Using this phenomenon, highly selective analytical method for TGOOH isomers was developed. This method clearly distinguished the mechanisms that contributes to edible oils oxidation (e.g. canola oil (2) and rice bran oil (3)).

Importantly, these isomeric structures provide the insights about not only oxidation mechanisms but also the structure of secondary oxidation products. Recently, we constructed the generation pathways of certain secondary oxidation products based on some factors such as the structure of lipid hydroperoxide isomers, radical delocalization, and the stability of resulted compounds (4). These pathways precisely predicted the resulted secondary oxidation products such as acrolein.

Therefore, these methods and insights would be valuable in the understanding of oil and food oxidation mechanisms, and may be applied to the development of preventive methods against food deterioration. In this symposium, I will introduce these analytical methods and obtained results.

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2) S. Kato et al., Determination of triacylglycerol oxidation mechanisms in canola oil using liquid chromatography-tandem mass spectrometry. *npj Science of Food*, 2, 1 (2018).

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4) S. Kato et al., Determination of acrolein generation pathways from linoleic acid and linolenic acid: Increase in acrolein generation by photo irradiation. *npj Science of Food*, in press.

Keywords: Lipid oxidation, Lipid hydroperoxide isomer, Oxidation mechanism, LC-MS/MS, GC-MS

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T8)5-3
Visualization of functional food factors by matrix-assisted laser desorption/ionization imaging mass spectrometry

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Food contains various functional food factors that have an impact on biological activities. Many technologies have been reported to analyze molecules of interest in foods. High-performance liquid chromatography-mass spectrometry or gas chromatography-mass spectrometry is solid approach to detect molecules of interest with high sensitivity. However, these technologies are not available for the analysis of the spatial distribution of molecules of interest. Matrix-assisted laser desorption/ionization mass spectrometry imaging (MALDI-MSI) is considered as an ideal complementary approach to visualize distribution of molecules in foods. MALDI-MSI is a two-dimensional MALDI-MS technology that can detect compounds in a tissue section without purification, separation, or labeling. MALDI-MSI can be used to visualize the spatial distribution of chemical compounds or biomolecules in foods. Although the methodology of MALDI-MSI in food science is not yet fully established, the versatility of MALDI-MSI is expected to open a new frontier in food science. Here, I would like to introduce the applications of MALDI-MSI and discuss the future in the field of food science.

Keywords: molecular imaging, Matrix-assisted laser desorption/ionization mass spectrometry imaging

Conflict of Interest Disclosure: N/A

SY(T8)5-4
Molecular species analysis of sphingolipids from marine invertebrates

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Marine invertebrates are a paraphyletic group that comprises more than 90% of all marine animal species, including mollusks, crustaceans, echinoderms, etc. Sphingolipids (SLs) are ubiquitous structural components of cell membranes and are essential for cell functions under physiological conditions or during disease progression. We propose that dietary SLs represent a “functional” constituent as emerging strategies for improving human health. However, the profiles of SL molecular species from marine invertebrates remain to be known very limited. According to our study, the species and contents of SLs in marine invertebrates are relatively abundant, including ceramides (Cer), sphingomyelins (SM), cerebrosides (HexCer), gangliosides (GLS), and some novel SLs such as ceramides 2-aminoethylphosphonate (CAEP) and deoxy-ceramides (DeoxyCer).

An RPLC-MS method was utilized and revealed that the percentage of SLs (Cer, HexCer, and SM) in shellfishes is considerable (18.8–38.6%). The characterization of their special long-chain base (LCB) structure (mainly d19:3) and N-acyl group (mainly 16:0) was realized. Furthermore, the d14:1 and d16:1 were the main LCB in Cer, HexCer, and SM of shrimp species with low content. In particular reference to sea cucumber, the LCB of HexCer mainly contains d17:1. We identified three GluCer subclasses from sea cucumber *Cucumaria frondose* and the most dominant molecular species were d17:1/24:1, d18:2/24:1, d18:2/24:1h, and t17:0/24:1h. The HexCer contents of sea cucumbers were 0.42-4.44 mg/g dry weight, among which *Bohadschia marmorata* was the highest.

A HILIC-MS analysis method was established to comprehensively investigate GLS, an acidic complex SL containing sialic acid (Sia). Invertebrate GLS have unique structures, containing N-acetylneuraminic acid (Neu5Ac), N-glycolyl-neuraminic acid (Neu5Gc), sulfated Neu5Gc and 3-deoxy-D-glycero-D-galacto-nonulosonic acid (KDN). We identified 17 special GLS subclasses in echinoderms. The polymerization degree of Sia in echinoderm GLS can be up to 4, and the linkage among Sias was mostly determined to be 2–8 or 2–11. Neu5Gc, sulfated and fucosylated Neu5Gc prevalently existed in echinoderm GLS. A new type of GLS with a phosphoinositidyled Sia was first characterized in sea cucumber *Bohadschia marmorata*. GM_4 was detected as a basic GLS structure of sea urchins and sea cucumbers, with different ceramide structures (t18:0/22:1h and d18:1/23:1h, respectively). Semi-quantitative analysis showed that the contents of GLS in echinoderms were 0.2–7.3 mg/g dry weight, with the highest GLS content in sea urchin *Glyptocidaris crenularis*.

Additionally, we established an NPLC-MS method for comprehensively identifying and semi-quantifying of complicated CAEP species from different marine invertebrates. Our study found that squid *Loligo chinensis* had the highest CAEP content (4.9±0.4 mg/g dry weight) and the most complex composition of molecular species, whereas starfish *Asterias amurenis* had the lowest CAEP content (1.9±0.6 mg/g dry weight), among five marine invertebrates (squid, mussel, oyster, neptunea, and starfish). Several DeoxyCer with low abundance (0.06–0.33 mg/g dry weight) were also detected in shellfish species.

These bioactive SLs have potential roles in revealing the nutritional value of marine invertebrates and serving as biomarkers for distinguishing different marine invertebrates. Moreover, our massive SLs data could facilitate the geographical origin traceability of aquatic products.

Keywords: sphingolipid, molecular species, content, LC-MS, invertebrate

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T8)6-1
Poly (D, L-lactide-co-glycolide)-phospholipid nanocarrier for efficient delivery of carotenoids

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Carotenoids (lutein, zeaxanthin, fucoxanthin, astaxanthin etc.) exhibit various biological activities. Their application in food and pharmaceutical industries are very much restricted due to meagre aqueous solubility, photo-, and thermal stability, and biological availability. The stability and bioavailability of carotenoids can be enhanced by nano encapsulation with a suitable polymer matrix and specific lipid carrier. To maximize bio-availability and bio-efficacy of carotenoids, we have developed lutein-poly (lactic-co-glycolic acid) (PLGA)-phospholipid (PL) nano carrier, chitosan (CS) - sodium tripolyphosphate (TPP) - glycolipid (GL) multifaceted nano system (CS-NGs) and chitosan-oleic acid-sodium alginate-based nano-carrier system (LNCs). These nano carriers were characterized for their physical and chemical properties and bioavailability of loaded carotenoids *in vitro* and *in vivo*. Nano carriers were found safe for application with no toxicity. The cellular uptake of lutein and fucoxanthin from nano system were higher than from mixed micelles. LNCs and CS-NGs displayed 1000-fold higher aqueous solubility. The mean size and zeta potential value of lutein-PLGA NCs (+PL) and CS-NGs were 100 to 140 nm and - 44 ± 5 mV and PDI of 0.174 ± 0.02. The amorphous nature of lutein in PLGA NCs (+PL) and CS-NGs was confirmed by XRD and DSC. *In vitro* lutein and fucoxanthin release kinetics showed an initial burst followed by sustainable release up to 85 to 90 %. *In vitro* bioavailability showed 62 to 70% higher lutein and fucoxanthin bio accessibility than form mixed micelles. The AUC of lutein and fucoxanthin after an oral dose of lutein-PLGA NCs (+PL) and CS-NGs revealed 3.91-fold (plasma), 2.89-fold (liver), and 3.12-fold (eyes) higher absorption than the control (mixed micelles) in rat model. A dose-dependent increase in plasma (135.20, 165.30 nmol/mL) and eyes (1.51 & 3.98 µg/g) was observed upon oral gavage of LNCs (10 and 100 mg/kg BW). The IC_{50} of lutein-PLGA NCs (+PL) in Hep G2 cells at 72 h was 4.5 µM as opposed to 23.4 µM for lutein in free form. Thus, results reveal that PL and oleic acid added to PLGA NCs and CS-NGs help in enhancing the solubility, stability of carotenoids which in turn resulted in higher bioavailability and bioefficacy and hence nano carrier system could be an efficient therapeutic tool to conquer macular degeneration, retinopathy and obesity complications owing to health benefits of lutein and fucoxanthin.

Keywords: Bioavailability, Biomaterials, Carotenoids, Lipids, Nanocarrier

Conflict of Interest Disclosure: No conflict of interest.

Further Collaborators: No collaborators.

SY(T8)6-2
Characteristics of fine lipid particles enhancing absorption of dietary lipophilic compounds

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Nutrients and other dietary functional components exhibit a wide range of chemical and physical properties, and thus the optimal intake of such beneficial food factors from natural and complex foodstuffs is often difficult. Intestinal absorption of lipophilic compounds depends on their solubility in the intestinal fluid to be delivered to the absorptive epithelium. It is well known that coexistence of lipids is essential for the absorption of lipophilic vitamins such as carotenoids and retinoids. There are a variety of nanotechnologies applying to drug delivery as well as dietary products to enhance the bioavailability of various functional components. In our study, vitamin E (α-tocopherol, VE) absorption was evaluated using fine lipid particle. VE solubilized with plant oil and processed to two types of water-soluble particles with emulsifiers were evaluated in our study. Water solubility was greatly enhanced with the fine-particle processing using food additive emulsifier with less than 100 nm as diameter, compared with soluble powder with approximately 1000 nm as diameter. When these samples were administered intraduodenally to the thoracic-lymph cannulated rats, the lymphatic transport of VE was higher with the Φ100-nm particle than with the Φ1000-nm particle. Absorbability of VE from the f100-nm particle was comparable to the post-prandial mimic solution. However, in the Caco-2 cell culture system, the Φ100-nm particle and the Φ1000-nm particle gave similar absorbability. The cellular uptake and the basolateral transport of VE were lower than when VE was administrated as the post-prandial mimic solution, indicating that the higher water solubility and nano-level diameter were not the critical features to accelerate the cellular uptake in the enterocyte. Interestingly, the absorbability of VE from the Φ100-nm particle in rats was reduced when Orlistat, a pancreatic lipase inhibitor, was co-administrated. The suppressive effect by Orlistat on VE absorption was not observed with the Φ1000-nm particle, suggesting that the inhibition of pancreatic lipase partly reduced the VE absorption from fine lipid particle. In conclusion, it is indicated that the fine lipid particle processing enhanced the absorption of VE *in vivo* via increasing the water solubility to enhance the accessibility to the intestinal mucosa. Also, the enlargement of the surface area of smaller particles may facilitate the lipid digestion within the particle following the micelle formation including VE.

Keywords: fine lipid particle, vitamin E, pancreatic lipase, Caco-2, rat

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T8)6-3
Colloidal aspects underpinning the digestion of lipid delivery systems

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Many bioactive food ingredients and drugs are poorly soluble in water and require lipid-based carriers to improve delivery and bioavailability. Understanding the colloidal behaviour and digestibility of lipids is essential for the design and formulate more effective lipid-based delivery systems. As lipids are immiscible with the water-phase, lipid digestion is a process which primarily occurs at the interface between the lipid and water phases. Hence the enzymes (lipases) which are water soluble must adsorb to the lipid surface for lipid hydrolysis (lipolysis) to take place. The interface is usually occupied and stabilised by adsorbed layer of surface active molecules such as emulsifiers, polar lipids, proteins etc. This layer can influence the colloidal stability and accessibility of the lipases to the lipid phase. Lipid digestion begins in the stomach, where the interfacial properties of the lipid phase can control coalescence, flocculation and creaming of the lipid phase, which can all affect lipid hydrolysis, but can also control the kinetics of lipid delivery to the small intestine. We demonstrated this by comparing the *in vitro* digestion of solid and liquid fats in a food matrix, which successfully reproduced the kinetics of plasma lipid appearance in a parallel human study. In the small intestine, lipolysis is further facilitated by bile salts which are emulsifiers and play multiple roles during duodenal lipid digestion, solubilisation of lipophilic bioactives and absorption. Understanding how bile salts interact with lipids, lipases and other food components will help us understand how these processes can be controlled to influence the rate and extent of lipid digestion. I will present some of the key factors which influence the colloidal behaviour and hence digestibility of lipid-based systems, supported by recent research which can be used to inform the design and development of more effective lipid delivery systems

Keywords: Lipid, Digestion, Delivery, Colloid, Interface.

SY(T8)6-4
Structure and functions of Lipid Droplets/Oleosomes

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Oleosomes, also known in biology as Lipid Droplets are storage organelles, found in all eukaryotic organisms. They have a unique architecture consisting of a hydrophobic core of neutral lipids, which is enclosed by a phospholipid monolayer that is decorated by a specific set of proteins. Oleosomes is the mechanism that organisms developed to safely store energy and use it when necessary. For this, the oleosome membrane is evolved to a metastable material, which is designed to withstand physical and chemical stresses but releases the neutral lipids upon specific stimuli. However, the structure-function relationship of the molecular components in the oleosome membrane is still not well understood and requires more attention to take complete advantage of their potential functions. Currently, we are investigating the molecular combinations at the oleosome membrane and their properties in different molecular soups. We aim towards understanding their physicochemical role in biological mechanisms and exploiting their properties in advanced and broad applications, from trafficking molecules to bio-catalysis.

Keywords: Oleosomes, lipid droplets, emulsions, carriers.

SY(T8)6-5
Microchannel Emulsification Technology for Dilute and Concentrated Oil-in-Water Emulsions

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Emulsions prepared by mechanical homogenizers are mostly polydisperse and rather unstable. More stable emulsions are needed for bioactives encapsulation. We have investigated the use fabricated microchannel for preparing monodisperse emulsions. Relatively efficient emulsification was achieved using asymmetrically structured microchannels with slit and microholes. The slit structure caused large distortion of the oil-water interface, and the interfacial tension induced spontaneous droplet formation. Laboratory-scale MC emulsification (MCE) equipment was already industrialized and used for various applications in food and chemical industries. Monodisperse emulsions in dilute condition up to 10% oil volume fraction was possible to formulate by microchannel emulsification. Highly concentrated emulsion is an emulsion system with high oil volume fraction, in which the droplets are closely packed together with advantages of its tunable textural properties, low water activity, large surface area features and high bioactives encapsulation. However, highly concentrated emulsions with higher internal fraction are often concerned about their coalescence stability due to the high droplet concentration. In this presentation, microchannel emulsification was used to prepare monodisperse oil-in-water highly concentrated emulsions and their stability were investigated, and compared with conventional mechanical homogenization in order to explore its potential to be applied in the food and nutraceuticals. Refined soybean oil was used as a dispersed phase whereas emulsifiers such as whey protein isolate and polyoxyethylene sorbitan monolaurate and sodium dodecyl sulfate. Highly concentrated emulsions prepared were characterized and evaluated based on their physical and chemical stability.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Monodisperse highly concentrated emulsions were successfully prepared with different emulsifiers with concentration as low as 0.5 wt%. The monodispersity of emulsion droplets showed good stability despite having relatively larger droplet size, which might be due to slight difference of Laplace pressure between droplets. Monodisperse highly concentrated emulsions prepared showed comparable or better physical and chemical stability than polydisperse ones. Highly concentrated emulsions prepared by microchannel also showed excellent chemical stability in preserving bioactive compounds. Hence, it could be potentially applied to food and nutraceutical products that carry high-value bioactive compounds.

Keywords: Microchannel emulsification technology, Monodispersed emulsion, Dilute emulsions, Concentrated emulsions

SY(T8)7-1
Chemoprevention by vitamin A and its derivatives

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Hepatocellular carcinoma (HCC) is a deathly cancer with increasing global deaths in the past 20 years. Progressive loss of total hepatic retinoid storage has been associated with the development of hepatic diseases including HCC. Acyclic retinoid (ACR) is an orally administrated vitamin A derivative that binds to cellular retinoic acid-binding protein with an affinity equal to that of all-*trans* retinoic acid, selectively inducing retinoic acid receptor-β-dependent signaling. ACR is the first agent to show promising efficacy and safety in phase 2/3 trials for the prevention of HCC recurrence in patients who underwent surgical removal of the primary tumors. However, a recent phase 3 trial with a specific focus on patients classified as Child-Pugh A reported no statistical superiority of ACR over placebo in inhibiting the recurrence of HCV-positive HCC (NCT01640808). Further studies identifying predictive biomarkers that indicate the response to ACR are essential for improving the treatment and prognosis of HCC.

Here, we performed a genome-wide transcriptome screen and identified that ACR suppressed the expression of a proto-oncogene MYCN selectively expressed in HCC cells but not in normal hepatic cells. Data mining of clinical datasets showed that MYCN expression in HCC was correlated positively with both cancer stem cell (CSC) and Wnt/β-catenin signaling markers, whereas negatively with mature hepatocyte markers. Immunofluorescence and flow cytometric analyses showed MYCN expression marked an EpCAM+ CSC-like subpopulation, which was selectively targeted by ACR. Proteome and metabolome analyses showed the expression of fatty acid desaturases and the content of unsaturated fatty acids were increased in MYCN high expression EpCAM+ CSC-like HCC cells. Inhibition of lipid desaturation using either the chemical inhibitor or siRNA/shRNA against stearoyl-CoA desaturase-1 (SCD1) suppressed cell proliferation as well as MYCN gene expression in HCC cells, grown as both monolayer and spheres. Mechanistic study using RNA-seq based transcriptome analysis revealed that endoplasmic reticulum (ER) stress related signaling networks such as endocannabinoid cancer inhibition pathway were under the control of SCD1 in HCC cells. The chemical inducer of ER stress inhibited MYCN gene expression, while the chemical inhibitor of ER stress partially rescued the suppression of MYCN gene expression by ACR in HCC cells. In the cohort studies in Japan, Taiwan and Europe, MYCN gene expression was expressed at higher levels in HCC tumor than in non-tumor tissues. There was a significant positive correlation between MYCN expression and recurrence of HCC with single tumor but not with multiple tumors. In a retrospective analysis of phase 3 trial of ACR, serum MYCN was identified as the risk factor mostly associated with HCC recurrence. HCC patients with a lower serum MYCN levels after a 4-week treatment period had a significantly lower risk of recurrence in ACR group, but not in placebo group.

In summary, MYCN holds promise for the biomarker-based precise medicine in the prevention of HCC with ACR.

Keywords: HCC, Vitamin A, Retinoid, Chemoprevention, MYCN.

SY(T8)7-2
Toxicity prediction of natural compounds

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Kampo medicine are composed of several crude drugs, a part of which are used as food. Each crude drug contains huge of natural organic chemicals, resulting in a complex multi-component system. On the other hand, there is no comprehensive report that investigates the information of crude drugs or the information of the ingredients contained and the safety information such as the results of toxicity tests. We comprehensively investigated the chemical structures of the substances contained in crude drug and predicted the potential toxicity in *Kampo* medicine preparations using computational toxicology techniques based on the structural formula information. The predicted items include cardiotoxicity, hepatotoxicity, and genotoxicity. The results of the calculations were compiled into a database, and to date, 40 formulations with the highest annual use and 1110 compounds contained in these formulations have been included in the in-house database. Next, we examined in detail the prediction of the inhibition of the hERG K^+ channel, which is the target for the evaluation of cardiotoxicity. We used the QSAR model of a commercially available program created by artificial neural networks, using experimental assay results of about 1000 compounds as training and test data. As a result, 52 compounds were estimated to be positive for inhibition. In addition, we constructed an ensemble model using a data set of about 14,000 compounds to improve the accuracy. In order to understand the interaction with hERG in more detail, we have started to study it by docking simulation. In this symposium, we will present these results.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Kampo, QSAR, hERG, toxicity

SY(T8)7-3
StemPanTox: a fast and wide-target drug assessment system using ES and iPS cells.

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The assessment of chemical effects on animals has limited consistency to humans. Adding consideration for animal protection, effective alternatives are desired. Previously, we developed a method that predicts developmental toxicity based on undifferentiated human embryonic stem (ES) cells using gene networks, achieving an extremely high performance (AUC = 0.93–1.00) for neurotoxins, genotoxic carcinogens, and non-genotoxic carcinogens. Here, we advanced this method to predict *adult* toxicities of 24 chemicals in six categories (neurotoxins, cardiotoxins, hepatotoxins, two types of nephrotoxins, and non-genotoxic carcinogens) and achieved high prediction predictability (AUC = 0.90–1.00) in all categories. Moreover, to develop a system with fewer ethical issues, we screened for an induced pluripotent stem (iPS) cell line to predict the toxicities based on the gene networks of iPS cells using transfer learning of the ES cell gene networks. We successfully predicted toxicities in four categories (neurotoxins, hepatotoxins, glomerular nephrotoxins, and non-genotoxic carcinogens) with high performance (AUC = 0.82–0.99). This system, called "StemPanTox", is applicable to a wide range of chemical toxicity assessments using iPS cells once a gene expression database has been developed from a standard stem cell line. This method holds promise for tailor-made safety evaluations using personalized iPS cells.

Keywords: Stem cell, Drug discovery, Chemical toxicity prediction, Gene network, Transfer learning

SY(T8)7-4
Food ingredients controlling cell differentiation and histone modifications

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1. Waseda University (Japan)

In Japan, one of the world's leading super-aged societies, the number of patients with neurodegenerative diseases such as dementia and Parkinson's disease is growing, and therefore counterplans are urgently needed. If there are functional ingredients that can prevent or treat neurological diseases in the foods we can consume daily, this could be one of the effective countermeasures. However, many food components do not show strong biological activity (highly active components may show toxicity), and many of them are thought to be effective when consumed daily over a long period. Therefore, it is essential to use a "highly sensitive assay system" to detect functional components in foods.

Neural stem cells (NSCs) are self-renewing pluripotent stem cells that can differentiate into neurons, astrocytes, oligodendrocytes, etc. NSCs are present not only during development but also in all adult mammals, including humans, and are known to continue providing differentiated neural cells throughout life. Recently, it has become clear that aging and mental stress reduce the differentiation potential of NSCs, suggesting a link to neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease. Therefore, compounds that regulate the differentiation of NSCs are expected as the prevention and treatment of these diseases.

We have developed an in vitro neural differentiation assay system using mouse embryonic stem cell (mESC)-derived neural stem cells (NSCs) and applied it to the search for functional food ingredients. This assay system can detect active substances affecting neural differentiation with high sensitivity. In addition, because this is an in vitro system, rapid analysis the mechanism of action is also possible.

On the other hand, histone modification, like DNA methylation, is one of the major mechanisms of epigenetic regulation of gene expression and is involved in various biological phenomena including cell differentiation during development. Histone modifications (acetylation, methylation, phosphorylation, etc.) occur at multiple sites on each histone molecule that makes up the nucleosome, and the modification patterns are complex. Therefore, the search for food components that change histone modifications requires an assay system that can detect them simultaneously and with high sensitivity. We have developed an assay system that monitors multiple histone modifications in parallel using more than 20 monoclonal antibodies specific for each histone modification.

Combining the above histone modification assay system with the in vitro cell differentiation model using mouse ES cells has enabled us to conduct not only search for functional food ingredients, but also earch for novel epigenetic drug materials and evaluation of the effects of environmental factors such as endocrine disruptors on gene expression.

In this presentation, we will introduce our recent results of the search for functional food ingredients with astrocyte

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

differentiation regulating activity and the analysis of their mechanism of action.

Keywords: cell differentiation, histone modification, bioactive food ingredients

Conflict of Interest Disclosure: No

Further Collaborators: Hiroshi Kimura
Yoko Hayashi
Naohito Nozaki

SY(T8)8-1
FRESH: A Global Fruit and Vegetable Research Initiative

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1.International Food Policy Research Institute (USA)

Fruit and vegetable intake is below recommended levels in nearly every country across the globe contributing to poor quality diets. Improving diets, including increasing intake of fruit and vegetables, could save one in five lives annually. In low- and middle-income countries (LMICs), the extent and nature of this nutrition challenge is poorly understood, due, in part, to insufficient dietary data. To increase fruit and vegetable intake issues related to availability, accessibility, affordability, and desirability need to be addressed. This will require using evidence-based approaches that address these issues throughout the value chain – from production to transportation and processing, to food environments to consumption.

In this Symposium, we will discuss a new research initiative developed in close partnership between CGIAR, the World Vegetable Center, and other partners, in which researchers will work with innovation, implementation, and scaling partners to address low fruit and vegetable consumption in LMICs. We aim to take an innovative, holistic end-to-end approach that begins with consumers, to better understand their dietary patterns and the barriers to increased fruit and vegetable consumption they face such as insufficient year-round availability of diverse fruits and vegetables (availability and cost); inadequate access to safe, diverse fruits and vegetables (accessibility); low income coupled with high prices of fruits and vegetables (affordability); and lastly, desirability where even when fruits and vegetables are available and affordable, intakes are still below recommended levels which requires a closer look at context and population-specific considerations preventing people from making healthy diet choices and identifying and testing innovative programs and policies to support healthy diets.

The subsequent presentations in this symposium will examine each of the issues listed above and provide insights as to how the FRESH Research Initiative will address these, and in some cases, will highlight some early findings.

Keywords: fruit, vegetables, production, diets, nutrition.

Conflict of Interest Disclosure: No conflicts

Further Collaborators: Ravi Gopal Singh (International Maize and Wheat Improvement Center) is the deputy lead for the FRESH Initiative and Pepijn Schreinemachers (World Vegetable Center) is the co-developer of the FRESH Initiative.

SY(T8)8-2
The use of fruit and vegetables to generate Income, improve diets and mitigate climate risks: a review of the evidence

Pepijn Schreinemachers[1], *Jody Harris*[1], *Rosaine Nerice Yegbemey*[3], *Sandhya S. Kumar*[2], *Mercy Mwambi*[1], *Christelle Marie Komlan*[3]

1. World Vegetable Center (Thailand), 2. World Vegetable Center (India), 3. World Vegetable Center (Benin)

Fruit and vegetables are an essential and irreplaceable part of a healthy diet. Global consumption of these foods falls well below recommended levels. A survey of people in 28 low- and middle-income countries found that 80% of individuals consume less fruit and vegetables than the World Health Organization recommends for good health. Low consumption of these foods is not just a key risk factor for human health, but also for planetary health as the mean carbon footprint of fruit and vegetables is much lower than animal-sourced food while providing key nutrients. Furthermore, the production and trade of fruit and vegetables generates profit and income that is often far greater than what farmers can earn from staple food grains.

Despite these purported benefits, fruit and vegetables have been relatively neglected in agricultural and food security policies due to a preoccupation with staple grains. Correcting this imbalance requires a sound understanding of how fruit and vegetables contribute to income, diets and climate change mitigation. Focusing on impact evaluation research undertaken by the World Vegetable Center and partners over ten years, we present a review of studies across the food system, from improved vegetable seed and agronomic practices adopted by farmers to the promotion of home and school gardens in rural areas, to awareness raising campaigns among consumers.

The review recognizes that pathways to impact can be long or short. An example of a long impact pathway is investments into vegetable breeding: new traits are incorporated into vegetable varieties that are sold to farmers who use it to produce a better crop, which they sell to consumers who desire these crops, and use the money earned to buy food. The time period from initial investment to ultimate impact can stretch for a decade or more in such impact pathway, and has many confounding factors that make it challenging to show numerically the exact pathways by which investments in vegetable breeding contribute to healthier diets. Consequently, the impact evidence is much stronger for shorter pathways. An example is the large body of literature on the impact of home gardens, which typically couple nutrition education with training in gardening and the supply of vegetable seed (sometimes also including small livestock or fish). Here the evidence is strong that home garden interventions can contribute to improved nutrition outcomes within a short period of time, although the success of home gardens depends much on the quality of intervention designs and local context.

In general, we observe a lack of high-quality studies on the impact of policies and interventions in the fruit and vegetable sector, particularly for low- and middle-income countries and for the longer impact pathways. Evidence is especially limited for the impact on greenhouse gas emissions. This review of studies

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

undertaken by the World Vegetable Center is feeding into a larger systematic review of interventions and impacts, and this session seeks feedback to further shape that review and identify gaps and opportunities.

Keywords: Impact evaluation, Impact pathway, Scoping review, Food system, Nutrition

Conflict of Interest Disclosure: The authors have no conflict of interest.

Further Collaborators: None

SY(T8)8-3
Sustainable intensification for safe food production

Ravi Gopal Singh[1]

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Soils can beneficially or adversely affect human health, and likewise human activity can impact soil health. Modern agricultural practices have affected soil health. Farmers are now using more fertilizer nutrients to produce optimum yield. Fertilizer consumption in developing world has increased significantly in last few decades. For example, in India, total NPK (N, P_2O_5 and K_2O) consumption increased nine-folds (from 2 million to 18 million tons) between 1970 and 2000. Per-hectare NPK consumption increased from 11 to 95 kg in the same period. Inappropriate fertilizer uses in intensive cropping led to several soil related problems including micronutrient deficiencies, salinization, acidification, and erosion. Research shows that intensive use of inputs creates a vicious cycle from which it is difficult to get out. For example, indiscriminate insecticide uses leads to a loss of natural predators and parasites and pest resurgence consequently, creating greater need for pest control. The changing climate affects the pathosystem including those that are already difficult to control are spreading to new areas, and the rapid emergence and spread of new or previously unimportant pests and diseases. Likewise, in commercial agricultural areas, repeated tillage can degrade organic matter, reduce hydraulic conductivity, and not only affect groundwater recharge but also reduce water storability of the soils, which makes soil vulnerable for erosion and paucity of soil water for crops. Under this context, our experience with conservation agriculture (CA) based crop management showed that optimal use of inputs and the systems functionality can make food production, economical, resilient, diverse, and sustainable. To restore soil function to optimum levels, crop diversity is essential. We found that sustainable intensification and diversification not only improved crop yields, enriching diet diversity but also reduced input use and risks. The sustainable intensification options helped in managing weeds, pests and diseases, efficient water use, enriched agrobiodiversity, less pesticide use resulting safer food production at lesser costs. The sustainable intensification and diversification with good agronomic practices and ecosystem service approaches can built system resilience to biotic, abiotic, and economic stresses.

Keywords: Conservation agriculture, Sustainable intensification, Safe food production

Further Collaborators: WorldVeg, Taiwan

SY(T8)8-4
Low cost interventions in value chains can reduce postharvest waste of fruits and vegetables

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People know that fruit and vegetables are good for them. Despite this, most people usually eat far less than the recommended five servings per day. The reasons for this may be cultural, price based, or simply that quality produce is not available. In many cases, high prices are a major barrier. This is frequently due not to lack of production, but to difficulties in getting fruit and vegetables from paddock to plate. In southeast Asia, it is estimated that 30 to 60% of fruit and vegetables grown are wasted. Long and complex value chains, lack of refrigeration and poor handling practices all increase losses. However, relatively simple interventions can have significant benefits. Here we present three case studies based on work in the Philippines, focussed on bitter melon, eggplant and mangoes. Interventions included modification of production practices (growing under a protective shelter), harvesting and packing method (avoiding bruising) and ripening technique (reduced time and/or gas concentration). All tested interventions increased saleable life. It is concluded that low-cost interventions can increase both availability and quality of fruit and vegetables, thereby facilitating increased consumption.

Conflict of Interest Disclosure: None.

Further Collaborators: None

Keywords: Mango, Bitter melon, Eggplant, Value chain, Postharvest

SY(T8)8-5
Creating food environments to support fruit and vegetable-rich diets

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The food environment is where the production and supply end of the food system meets the consumption and food intake end, sometimes but not always through markets. Core elements of the food environment include availability and access to foods; vendor and product characteristics, price and affordability of foods; and marketing and regulation that structure the environments within which people access foods that form a healthy diet, including the policy, programmatic and economic drivers of these. The food environment covers aspects outside of immediate consumer preferences that structure and shape food choice, both towards healthy diets and under-and over-nutrition outcomes. Food environment descriptions and diagnoses are limited, and largely undertaken in high-income countries, though these are beginning to be done in some LMIC contexts. Interventions into food environments (again largely in high-income contexts) focus on wider questions of accessibility (including school or other institutional meals including local procurement, and bringing healthy foods such as fruits and vegetables closer to consumers; affordability (including consumer-end fruit and vegetable subsidies, and more general social protection92); and how the wider product, retail and regulatory environment shape food environments (including labelling and advertising of foods and zoning law). Policy choices and policy processes underpinning these areas has started to be assessed as a route to sustainable intervention. The strongest evidence favors multi-component interventions in the food environment for fruits and vegetables. Our research questions and outputs are focused on 1) diagnosing and understanding fruit and vegetable food environments and 2) applying and innovating new fruit and vegetable focused interventions. To do so we follow a mixed methods approach including household and retail surveys; qualitative assessments of the lived experience of food environments; affordability studies geospatial analysis, policy and equity process and case study approaches and impact evaluations. In understanding fruit and vegetable food environments, we examine the following key research questions: 1) What are the characteristics of food environments in relation to fruit and vegetables? 2)How do these vary by time and context and for different populations? 3) What evidence exists on food environment interventions? 4) What are the political economy and equity dimensions enabling and disabling such options? We will present initial findings on understanding of fruit and vegetable food environments in Sri Lanka and Benin.

Keywords: dietary diversity, food environments, fruit and vegetables

Conflict of Interest Disclosure: None

Further Collaborators: Deanna Olney, IFPRI
Jody Harris, World Vegetable Center
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SY(T8)8-6
Intake of fruit and vegetables among men and women in rural Sri Lanka

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Background and objectives: Worldwide poor-quality diets are the leading cause disease and a primary cause of all forms of malnutrition. Improving diets, including increasing intake of fruit and vegetables, could save one in five lives annually. In this study we assessed dietary intake among men and women in rural Sri Lanka as part of an evaluation of the effectiveness of a nutrition-sensitive resilience building program implemented by the World Food Programme and their partners within the Government of Sri Lanka and with the Foundation for Health Promotion. Our primary objective was to assess the dietary patterns of the survey participants (program participants and a control group) and to assess program impact on dietary intake. Here our primary objective is to examine intake of fruits and vegetables among men and women in rural Sri Lanka.

Methods: All dietary data across three time points were collected through 24-hour recall interviews, conducted over the phone by trained enumerators from Wayamba University of Sri Lanka. Here we report the findings from the endline survey conducted with 1080 participants. Dietary intake data was categorized following the food group definitions recommended by the FAO for use among women of reproductive age. Data was further disaggregated for men and women.

Results: Intake of fruits and vegetables was common, with over 90% of respondents consuming at least one fruit or vegetable in the prior 24 hours. However, only about one-third of survey respondents ate dark green leafy vegetables and about one-quarter ate vitamin A-rich fruit and vegetables in the 24 h prior to the survey. No meaningful differences between men's and women's intake of fruits and vegetables were detectable at endline.

Conclusions: Although intake of fruit and vegetables is common among adults in rural Sri Lanka, intake of dark green leafy vegetables and other vitamin A-rich fruits and vegetables is less common. Future analyses will assess whether a nutrition-sensitive resilience building program was successful in improving diets among men and women in rural Sri Lanka, including their intake of fruit and vegetables.

Keywords: Sri Lanka, diet, fruit, vegetables, adults

Conflict of Interest Disclosure: None of the authors have any conflicts of interest.

SY(T8)9-1
Challenges and opportunities for Codex Texts on Nutrition

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The Codex Alimentarius Commission has a specific Committee dealing with Nutrition and Foods for Special Dietary Uses. It works closely with the Codex Committee on Food Labelling and answers questions posed by that committee. It receives scientific advice from the Joint FAO/WHO Expert Meeting on Nutrition. The presentation will explore the work achieved so far, the ongoing and planned projects as well as the related challenges and opportunities for the future.

Keywords: Standards, Codex Alimentarius, FAO, WHO, science

SY(T8)9-2
Risk management for microbial hazards in foods

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Foodborne diseases caused by microbial hazards constitute significant public health concerns worldwide. Human beings have fought against microbial foodborne diseases since before the recorded history. Microbial hazards include bacteria, viruses, fungi and parasites. Toxins and other harmful metabolites are chemical hazards but produced by microorganisms. If food-producing animals are infected with microorganisms, in most cases, the animals do not have visible symptoms. As we got over some microbial hazards, new hazards, such as Shiga toxin–producing Escherichia coli, antimicrobial resistant bacteria and prions, appeared and spread. In human eating habits and diets, many changes have occurred over the last few decades. For example, in Japan, low-salt foods, uncooked or lightly cooked foods are widely available now. Imported foods are also common. These foods are available not only from the market but also from the Internet. The government promotes the consumption of game meats. Therefore, when dealing with microbial hazards, these complex and changing situations should be considered and a science-based approach is essential. For this, risk analysis serves as a good and useful tool in evaluating and controlling microbial hazards to protect the health of consumers and ensure fair practices in food trade. The Codex Alimentarius Commission adopted the 'Principles and guidelines for the conduct of microbiological risk management (MRM)' in 2007. The eight general principles for MRM are: (1) Protection of human health is the primary objective in MRM; (2) MRM should take into account the whole food chain; (3) MRM should follow a structured approach; (4) MRM process should be transparent, consistent and fully documented; (5) Risk managers should ensure effective consultations with relevant interested parties; (6) Risk managers should ensure effective interaction with risk assessors; (7) Risk managers should take account of risks resulting from regional differences in hazards in the food chain and regional differences in available risk management options; and (8) MRM decisions should be subject to monitoring and review and, if necessary, revision. This presentation focuses on the second general principle for MRM; and introduces the prevalence of non-typhoidal Salmonella spp. and measures for controlling Salmonella infection/contamination in chickens and chicken eggs in the whole chain of chicken egg production/distribution in Japan. Since late 1980's, the annual number of food-poisoning outbreaks caused by Salmonella spp. has sharply increased. While risk analysis was not introduced yet in Japan for microbiological food safety until early 2000's, the Government of Japan implemented many control measures based on scientific data in the whole food chain. As the results of these control measures, the number of the outbreaks have decreased since 2000. Even at the present time, Salmonella is still main cause of bacterial outbreaks, the current main source food of the outbreaks is chicken meat rather than chicken eggs in the past. To further decrease the outbreaks, the reduction in Salmonella contamination of chicken meat is necessary. This example of chicken eggs helps understand the importance of the application of "food chain approach".

Keywords: Risk management, Microbial hazard, Food chain approach

SY(T8)9-3
Precision food safety -using whole genome data to inform risk assessment in food safety

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Foodborne disease surveillance is now at a critical juncture. Whilst remaining firmly embedded in the principles of risk analysis; including assessment; management and communication, technological developments have opened up new opportunities for food safety, in its pursuit of the protection of public health. Microbiological food safety has traditionally been monitored using culture-based protocols designed to detect; characterise and identify the target foodborne pathogen. Bacterial pathogens have been mainly studied at the species level without any consideration being given to the microbiological context, from which the bacterium was originally recovered. Technological advances in high-throughput DNA sequencing in the early 2000's have made available accurate

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

sub-typing protocols that can be deployed to track foodborne pathogens across the food chain whilst describing the associated microbial communities, from which they have arisen. These advances have rapidly changed the approach to foodborne disease surveillance and the assessment of risk to human health. This paradigm shift hearlds the era of ***precision food safety***. In this presentation, examples demonstrating the application of DNA sequencing in the context of microbiological food safety will be presented. These will describe strategies used to accurately identify bacteria and genotypes of importance to food safety whilst considering challenges to food microbiological risk assessment of the future.

Keywords: Food Safety, Whole genome sequencing, Risk assessment, bacterial hazards

Conflict of Interest Disclosure: none.

Further Collaborators: none

SY(T8)9-4
U.S. Food and Drug Administration Activities to Address Chemical Contaminants in Food

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1. U.S. Food and Drug Administration (USA)

The U.S. Food and Drug Administration (FDA) enforces the Federal Food, Drug, and Cosmetic Act, a law intended among other things, to ensure that the U.S. food supply is safe for human consumption particularly when it may contain poisonous or deleterious substances. FDA conducts a broad range of activities to address food-borne natural and anthropogenic chemical contaminants. FDA activities include the development of analytical methods for testing food as well as targeted and non-targeted monitoring of food for contaminants. FDA also uses science-based risk analysis including risk assessment to determine if contaminants may pose a health risk, and risk management and risk communication to protect the public health.

Keywords: USFDA, chemical contaminants

SY(T8)9-5
Excess intake of micronutrients: evaluating the risks for human health

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Less than one century ago, thiamine was the first vitamin isolated. An era of active research had kicked off and most essential vitamins and minerals were identified by the mid-20th century. In the wake of the discovery of their role in 'deficiency diseases', the chemical synthesis of micronutrients led to the development of treatment and prevention strategies based on single nutrient substance, consumed in the form of food supplements or fortified foods. Policies of fortification of staple foods were introduced in the 1930s and developed around the world during the whole century. These approaches were effective at reducing the prevalence of many common deficiency diseases, such as pellagra (niacin), goitre (iodine), and microcytic anaemia (iron).

However, like other chemicals, micronutrients can lead to adverse health effects if consumed in excess. As research raised concerns about too much of a nutrient, policymakers and regulatory authorities sought scientific advice to characterise and manage associated risks. The nutrition community introduced the concept of "tolerable upper intake level" (UL) in the 1990s, defined as the maximum daily intake above which a nutrient may cause adverse effects. Nutrient risk assessment adapted approaches developed for other food chemicals consisting in 4 steps: hazard identification, hazard characterisation, exposure assessment and risk characterisation. Yet, distinctive characteristics of micronutrients were recognised: there is a (lower) level of intake below which risk of deficiency or sub-optimal functioning arises, and most nutrients are subject to homeostatic regulation of body content, which provides protection against exposures above usual intakes. Early risk assessments focussed on characterising the toxicity profile of the nutrient and intake levels up to which "no adverse effect" was observed (equivalent to a 'NOAEL' for chemicals). The evidence was often limited to animal experiments, case reports or incidental findings from human trials which had aimed at exploring the potential benefits of "high dose" micronutrient intake.

Over the past two decades, the knowledge and understanding of potential adverse effects related to excess intake of micronutrients has evolved, with growing concerns that they may contribute to the risk of chronic diseases. This raises new scientific questions and challenges the traditional conceptual framework of ULs. Reflections regarding the types of effects that could inform the derivation of an UL ('biologically based model') also progressed, paving the way for novel assessment strategies. Also, scientific authorities throughout the world have strengthened their risk assessment processes through the development of systematic and transparent methodologies. Meta-analysis, dose-response modelling and structured approaches to evidence integration are increasingly used to support evidence-based conclusions.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Moving into the 21st century, the market of food supplements and fortified (‘functional') foods continues to grow, led by emerging trends: attention to physical and mental well-being, slowing down of the aging process, cure of metabolic disorders. This makes current consideration of upper levels for micronutrients highly relevant for public health. This presentation discusses the principles applied in recent nutrient risk assessments of the European Food Safety Authority, and the methodological progresses that occurred in the field.

Conflict of Interest Disclosure: None

Keywords: micronutrient, risk assessment, food safety, upper level

SY(T8)10-1
Overview: The “Nutrient-Repositioning” -Unexpected Amino Acid Functions -

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“Repositioning” is usually used to indicate drug repositioning, or the finding of new disease applications for existing, approved drugs. Nutrients such as proteins, fats and carbohydrates are substances that organisms need to live and grow. Proteins are made of amino acids which are organic compounds with amino and carboxy group. Amino acids are also degraded for gluconeogenesis as well as biogenesis of nucleic acids, phospholipids, aminosugars, hormones and neurotransmitters. Moreover, they themselves have physiological functions through their binding proteins such as leucine and arginine, activators for mammalian target of rapamycin complex 1 (mTORC1), a highly conserved serine/threonine protein kinase, promoting protein synthesis (translation) and inhibiting protein degradation by suppressing autophagy. So far, the individual amino acids have been revealed to have new physiological functions and indicated the possibilities applying them as functional food factors (also called “neutraceuticals”) for promoting human health in addition to traditional nutrients. In the pharmaceutical field, finding new efficacies of existing drugs and repurposing them for other diseases is called as drug repositioning (also known as redirecting, repurposing and reprofiling) which helps reducing the cost and risk for developing new drugs in pharmaceutical companies. As above, nutrients including amino acids have multiple functions and act as pharmaceuticals, so that we propose the discovery of effects different from the existing effects of nutrients as "nutrient-repositioning”.

Keywords: repositioning, amino acid

SY(T8)10-2
The new findings of disordered BCAA catabolism for metabolic disease

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Dysregulation of glucagon is associated with the pathophysiology of type 2 diabetes. In fact, glucagon receptor antagonists have been shown to decrease blood glucose levels in type 2 diabetes. We previously reported that postprandial hyperglucagonemia is more obvious than fasting hyperglucagonemia in type 2 diabetes patients. However, which nutrient stimulates glucagon secretion in the diabetic state and the underlying mechanism after nutrient intake are unclear.

To answer these questions, we measured plasma glucagon levels in diabetic mice after oral administration of various nutrients. We found that protein, but not carbohydrate or lipid, increased plasma glucagon levels in diabetic mice. Among amino acids, BCAAs, but not the other essential or nonessential amino acids, increased plasma glucagon levels. To clarify the molecular mechanism, we also assessed the effects of nutrients on glucagon secretion by using islets isolated from diabetic mice. In addition, we analyzed the expression levels of branched chain amino acid (BCAA) catabolism-related enzymes and their metabolites in diabetic islets. We found that the expression levels of BCAA catabolism-related enzymes and their metabolite contents were altered in diabetic islets compared to control islets, indicating disordered BCAA catabolism in diabetic islets. Furthermore, BCKDK inhibitor BT2 suppressed BCAA-induced hypersecretion of glucagon in diabetic islet. Taken together, postprandial hypersecretion of glucagon in the diabetic state is attributable to disordered BCAA catabolism in pancreatic islet cells. Considering that disorders of BCAA catabolism have been reported in the heart, liver, and brown adipose tissue in various metabolic diseases, disordered BCAA catabolism may be a common cause of various metabolic diseases, including type 2 diabetes.

We also propose that this study not only clarifies important pathophysiological aspects of diabetes but also provides potential applications for dietary therapy.

Keywords: glucagon, diabetes, branched-chain amino acid, pancreatic alpha cell

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T8)10-3
Assessment of histidine-associated pathophysiology in leukemia patients and mouse models

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Histidine is an essential amino acid that has several functions beyond protein synthesis; Histidine is a precursor for carnosine and histamine - anti-inflammatory and immune-modulatory molecules, as well as for trans-urocanate - a natural sunscreen molecule. Excess histidine is degraded in cells through the histidine degradation pathway. Histidine catabolism requires the coenzyme folate (tetrahydrofolate, THF), that is also required for nucleotide synthesis and other metabolic processes. This requirement associates histidine degradation with metabolic pathways that are essential for fast proliferating cells such as cancer and activated immune cells. Further, because folate is a target for anti-cancer and autoimmune diseases therapy, the histidine degradation pathway becomes relevant for these therapies, as a consumer of folate. Indeed, we have previously shown that histidine supplementation in mice, that boosts histidine degradation, sensitizes leukemia cells to the anti-folate methotrexate (MTX) through increased consumption of THF by the histidine degradation pathway. This resulted in inhibition of *de novo* nucleotide synthesis, restricted tumor progression, and improved survival of leukemia-bearing mice. These findings present an opportunity to enhance efficacy of anti-folate therapy by supplementation of histidine, and this can allow lower doses of the anti-folate drugs that are notorious for their side effects, especially in the brain. In order to advance these findings to clinical applications, we are addressing the feasibility of histidine supplementation for enhanced anti-folate treatment in the primary and secondary sites of pediatric acute lymphoblastic leukemia (ALL) - the blood and the brain, in ALL mouse models. Further, in humans, excess histidine was detected in the plasma following histidine supplementation, but currently no such data exist for the brain, and for the site of leukemia brain lesions – the cerebrospinal fluid (CSF). Therefore, we study the levels of histidine with disease progression and following anti-folate therapy in the brains of pediatric ALL patients with and without central nervous system (CNS)-involvement of the leukemia. These studies will guide further investigation in ALL mouse models, where we can identify feasibility and optimal timing and duration of histidine supplementation for enhanced anti-cancer therapy. Further, our work will inform clinical studies in patients treated with anti-folate therapy. The potential to develop modern treatments that incorporate metabolic drugs or dietary therapy enhancement is transformative for health equity: we are proposing to incorporate a cost-effective therapy or nutritional modifications, which can be financially accessible to all, in the standard-of-care regime and offer more hope to patients from underserved communities.

Keywords: nutrition, histidine, folate, cancer, leukemia

Conflict of Interest Disclosure: none

SY(T8)10-4
Effects of food ingredients on back pain and knee pain

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1. Ajinomoto Co., Inc. (Japan)

Multisite pain, including low-back and knee pain, is a major health issue that greatly decreases quality of life. This study demonstrated the effects of l-serine, which provides necessary components for nerve function, and eicosapentaenoic acid (EPA), which exerts anti-inflammatory properties, on pain scores of adults with pain in the low back and/or knee for at least 3 mo. The participants were randomly allocated to either the active group (daily ingestion of 594 mg l-serine and 149 mg EPA) or placebo group. The Japan Low Back Pain Evaluation Questionnaire (JLEQ) scores at week 8 were lower in the active group. The Japanese Knee Osteoarthritis Measure (JKOM) scores at week 4, week 8, and week 12 were lower in the active group. Additionally, the active group had 11-27% better scores compared with the placebo group for the Brief Pain Inventory. No adverse events were observed. l-Serine and EPA were effective for pain relief in adults with low-back and knee pain.

Keywords: Amino Acid, Omega-3 Fatty Acid, low-back and knee pain, multiple site pain, neuropathic pain.

Conflict of Interest Disclosure: The speaker is an employee of Ajinomoto Co, Inc.

SY(T9)1-1
Dietary intervention studies and new aspects of gene – diet interactions

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We have a strong history of successful prevention strategies and studies for preventing lifestyle related diseases in Finland. The extremely high cardiovascular mortality in an eastern province North Karelia in Finland caused great concern in 1970s, when North Karelia project was launched. Due to this successful project, coronary mortality was reduced in middle age population by 84% from 1972 to 2014. Another good example is the Finnish Diabetes Prevention Study (DPS) which was one of the first controlled, randomized intervention studies to show that type 2 diabetes (T2D) is preventable with lifestyle intervention. The risk of diabetes was reduced by 58% in the intensive lifestyle intervention group compared with the control group. Nowadays it is known that many lifestyle related diseases

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

are multi-factorial and arise from the interaction of gene variants, lifestyle and environmental factors. This is a new important aspect to study. Understanding of complex relationship between genes, nutrition and metabolism is a way to more personalized nutrition. The most powerful study design to investigate gene-lifestyle interactions are intervention studies including individuals selected based on their genotypes. These kind of studies are scarce, since they can be done only based on large genotyped population. We have been privileged to be able to invite people with specific genotype from the Metabolic Syndrome in Men (METSIM) study including over 10 000 men with detailed phenotype and genotype data. We have recently conducted three genotype based intervention studies. The largest one compares the effects of lifestyle intervention on the prevention of T2D in people with high genetic risk for T2D compared with people with low genetic risk for T2D based on the genetic risk score including 76 risk genes. Two other interventions use a candidate gene approach with focus on *PNPLA3*, which is associated with hepatic lipid accumulation and chronic liver diseases including non-alcoholic fatty liver disease (NAFLD), and *FADS1*, which strongly regulates responses to dietary intake of polyunsaturated fatty acids. These interventions included modification of dietary fat intake. These projects aim to reveal whether the genetic screening and individualized intervention programs are needed to effectively prevent and optimize the treatment of these multifactorial, lipid metabolism related diseases T2D and NAFLD.

Keywords: nutrition, intervention, human, gene, type 2 diabetes

SY(T9)1-2
Nordic foods and diet– what can we learn about them applying metabolomics approach?

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Nordic countries are well known for their clean nature and its products. The concept of a Nordic diet has gained great research interest recently. Traditional Nordic foods such as whole grain rye, barley and oat, various Nordic berries and fruits, cabbage, roots and tubers, native fish and wild land-based animals as well as rapeseed oil have been the target of many nutritional studies, especially in the Nordic countries. Thus, the knowledge and understanding on these foods and more recently on the whole healthy Nordic dietary pattern has been increasing, and proving evidence that it may be as healthy as the traditional Mediterranean diet when composed of healthy Nordic counterparts, *i.e.* local Nordic foods. Metabolomics technology offers a possibility to study both foods and human metabolic responses on them facilitating understanding on deep interactions between food, gut microbiota, and physiological responses. Indeed, following recent advances over the last years, metabolomics has become a fundamental tool to study changes in molecular phenotype caused by molecules inherent to different exposures, including diet, and their interaction with host wellbeing, risk of disease or other outcomes. The same development has been going on in food science to investigate the effect of technological processes on the food biochemical composition that is relevant in terms of their potential health benefits. In addition, metabolomics can provide new and unexpected biomarkers of foods that are associated with disease development and prevention. In this presentation I will provide demonstration on various studies related to the Nordic foods and diet assessed with non-targeted metabolite profiling approach. I will show how metabolomics can be utilized to profile the rich biochemical content of foods, how it aids in understanding the metabolic conversions gut microbiota has on the dietary compounds, and eventually how we can utilize the technique to assess the impact diet and gut have on our endogenous metabolism and health thereafter.

Keywords: metabolomics, microbiota, food, biochemicals, metabolites

SY(T9)1-3
Successful vitamin D policy in Finland – a model for other countries?

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Finland is an example of successful vitamin D food fortification policy that has contributed markedly to the country's improved vitamin D status in the population. This presentation gives insights into the reasons, decisions, implementation and effects of vitamin D food fortification in Finland.

In the beginning on 2000's, low vitamin D status was demonstrated as a potential public health problem in healthy adults in Finland as a consequence of a lack of dermal synthesis of vitamin D3 during the wintertime because of limited UVB irradiation and low dietary vitamin D intake. Vitamin D fortification of widely consumed staple foods, fluid milk products, as well as fat spreads started in 2002. The fortification levels were based on scenarios and the effects of implementation on the adult population's vitamin D status were strictly followed up. As the observed effects on the population's vitamin D status were not strong enough, the recommended fortification levels were doubled in 2010, the recommended fortification amounts being for fluid milk (except for organic ones) 1 microgram per 100 g and for fat spreads (not butter) 20 micrograms per 100 g. As a consequence, in 2011, the majority of the adult population had adequate vitamin D status (serum 25-hydroxyvitamin D $\geqq$50 nmol/l). Even though the fortification policy is voluntary, almost all domestic manufacturers follow the current fortification recommendations. The success story has

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

been strongly based on the willingness of the food industry to implement the recommendations. Increased vitamin D supplement use has also contributed to the improved vitamin D status. The National Nutrition Council has given instructions on vitamin D supplementation to ensure adequate vitamin D intake in the most vulnerable population groups.

Keywords: vitamin D, food fortification, 25-hydroxyvitamin D, food policy, Finland

SY(T9)2-1
The International Impact of Tadasu Saiki and the Imperial Institute of Nutrition (Tokyo, 1916-1945)

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This paper analyses the international impact of Tadasu Saiki and the Imperial State Institute of Nutrition during the interwar years (1916-1945). Is starts by presenting the figure of Dr Tadasu Saiki, his origins, his instruction as a university student in Japan, his doctoral and postdoctoral research at the United States, and the initiative to create a predecessor of Institute of Nutrition. This initiative took place at a time of very critical context, during the Great War, under very hard sanitary and dietary conditions. My paper explains the dietary condition of the population and Saiki's nutritional ideology, in order to improve the physical and physiological condition of the Japanese population. Supported by the Japanese Government, Saiki explained his experience to the authorities at the League of Nations, and his lectures and reported caused strong impact among European and American experts. As a result, the prestige and international impact of Japanese research and social policies around nutrition grew and the exchanges with international experts were frequent and fruitful.

Keywords: Tadasu Saiki, Imperial Institute of Nutrition, international impact, Tokyo, 1916-1945

SY(T9)2-2
The National Health and Nutrition Survey in Japan: a history of 75 years

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1. National Institute of Biomedical Innovation, Health and Nutrition (Japan)

Objectives: The National Health and Nutrition Survey, Japan (NHNS; formerly the National Nutrition Survey) has been conducted every year in Japan from 1945- 2019. From its start and to the present, it has evolved in order to focus on current public health issues, which is its unique characteristic. We aim to summarize the history and origins of this unique national survey and describe its present situation. Methods: Officially published national reports were investigated to obtain information on the aims, survey areas, subjects, and survey items of the NHNS. Results: The National Nutrition Survey in Japan was initiated with the aim of obtaining information about food supplies due to post World War 2 food shortages. After the problem of food shortage was resolved, the survey objective of the NHNS has changed, to monitor the health status of the population so that the government could comprehensively promote health in accordance with enacted laws. The survey was designed to provide national representation through randomized selection and was initially planned to assess dietary intake, anthropometric measurements, and physical symptoms among the Japanese. At present, it is conducted in three parts that collect nutrition, physical, and lifestyle data. Consequently, the purpose and content of the NHNS have expanded over time. Throughout its 75-year history, the NHNS has continued to monitor Japanese dietary intake and health status, further contributing to various national policies on health, food systems, and nutrition. However, the 2020 and 2021 surveys were not conducted due to the COVID-19 pandemic. Conclusion: The current state of health in Japan may be largely due to the contributions of the NHNS to public health through public health policy based on survey results. We hope that the NHNS continues to develop in the future, to continuously monitor the health status of the population even in times of pandemic.

Conflict of Interest Disclosure: There are no conflicts of interest to declare.

Keywords: Tajima[1], Tomoko national survey, nutrition, diet

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T9)2-3
AI nutrition: Application of AI technology in nutrition field

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The AI nutrition project started in April 2020 at the National Institute of Biomedical Innovation, Health and Nutrition. Through collaboration with the Artificial Intelligence Center for Health and Biomedical Research (ArCHER) and various researchers, we are advancing data science using artificial intelligence (AI), machine learning, and numerical analysis technology while accumulating evidence related to health and nutritional metabolism such as various cohort data, measurement data, and open data. At the same time, we are also developing AI/data analysis technology for handling multi-scale data from the molecular level to the individual/population level.

In the development of AI analysis platform, we are promoting the development of algorithms and systems that will be the basis for various high-dimensional data analysis. Specifically, in addition to developing multiple types of dimension compression/visualization technology and machine learning technology, we are also developing AI/data analysis technology that matches various data including numerical and information analysis. Using these technologies, we are developing indicators for defining health and nutrition such as frailty syndrome and estimation of total energy consumption, food classification, and so on.

As a molecular-level approach, we are building a metabolism model to accumulate metabolism-related evidence such as food and intestinal bacteria. In metabolic model development, we mainly use deep learning technology to estimate the metabolic network from genome/amino acid sequence information, that is, to develop technology for searching and designing unknown metabolic reactions. In the metabolism model analysis, we are conducting a metabolism simulation of the intestinal flora and an analysis of health food/drug interactions.

It is expected that these efforts will lead to new evidence and findings in digital health and nutrition fields, and intervention proposals for improving individual healthier lifestyles and self-care. As health issues in individual lifestyles have begun to attract attention, we aim to formulate advanced health measures in detail according to the individual's health condition through AI nutrition research.

Keywords: data science, artificial intelligence, machine learning, numerical analysis, digital health.

SY(T9)2-4
Frontiers in Disaster Nutrition - Establishment of a special section of disaster nutrition.

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1. National Institutes of Biomedical Innovation, Health and Nutrition (Japan)

The Global Disaster Nutrition section was established at the National Institute of Biomedical Innovation, Health, and Nutrition in 2018. This is the first section dedicated to dealing with nutrition after disaster in Japan. The slogan of us is “evidence to action.” The mission of our section is to reduce health and nutrition problems associated with natural disasters and pandemics.

To achieve this mission, there are three main tasks: 1) Research for reducing food and nutrition problems after natural disasters, 2) development of nutritional assistance systems after disasters, and 3) provision of information and support tools.

Specifically, our section works during natural disasters to collect information about food and water using the Ministry of Health, Labour, and Welfare online Emergency Medical Information System (EMIS), in addition to other information systems in disaster areas, and to share it with the local governments and institutes responsible for providing and controlling food and water. In addition, this section provides information leaflets on disasters for nutrition and diet, hygiene control, baby and mother, and elderly and non-communicable diseases in English, Spanish, Tagalog, Hangul, Vietnamese, and Chinese on their website.

Keywords: disaster, health, nutrition, pandemics

SY(T9)3-1
The challenge of nutrition leadership in a globalized world

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Addressing today's nutritional problems requires effective leadership across sectors (academic, corporate, governmental and non-governmental), across scientific disciplines (from biochemistry to policy analysis), and across cultures and countries. Strong leadership skills are needed to build effectives

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

alliances, identify evidence gaps, seize opportunities for action, to effectively communicate to varied audiences about nutrition at the individual, organizational, and system levels, and to positively affect nutrition outcomes through better decision making.

The session brings together a panel of distinguished leaders in nutrition from around the globe who are active in the private sector, the public sector, and academia.

After brief introductions and opening remarks, a participative session on leadership will follow in which the audience will be invited to express their views. The panel will conclude with key lessons learned.

Keywords: nutrition, leadership, academia, civil society, private sector.

Conflict of Interest Disclosure: None

SY(T9)4-1
Cost and affordability of a healthy diet: Global analyses of food prices for nutrition

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This presentation will summarize results of global and national studies using new metrics for each population's access to a healthy diet, using retail prices of the least expensive locally available items needed to achieve nutrient adequacy and meet food-based dietary guidelines. These new metrics of diet cost and affordability were developed since 2016 at Tufts University, in partnership with the FAO and the World Bank as well as IFPRI and numerous collaborators in Africa, Asia and Latin America through a project now known as Food Prices for Nutrition. The metrics match price observations with food composition data to compute the least-cost combination of locally available items to meet nutritional needs, thereby tracking the ability of agriculture and food systems to supply healthy diets at time and place. Globally we find that about 3 billion people cannot afford even the least-cost foods needed to meet national dietary guidelines, with significant spatial and seasonal variation within countries. Least-cost diets provide an operational definition of food access, distinguishing among possible causes of inadequate diets to guide policy and program interventions. At times and places where even the least-cost items are relatively expensive, improvements in agricultural production and food distribution would be needed to reduce price. Where it is not possible to reduce diet costs, lack of affordability could be addressed through transfer programs, safety nets and social protection. For over 60% of the world's population, however, we find that retail items for a healthy diet are already affordable but may not be consumed for other reasons, including the time costs of meal preparation and preferences for attractive but less healthy items. Using least-cost diets to track affordability of healthy foods provides a useful complement to other metrics, providing internationally comparable measures for the cost and affordability of healthy diets. Methods and data have been updated by UN agencies in each annual SOFI report (FAO, IFAD, UNICEF, WFP and WHO 2020, 2021 and 2022) and also used in a variety of other settings as shown at https://sites.tufts.edu/foodpricesfornutrition. Global and subnational findings discussed in this presentation have specific relevance to closing gap in micronutrient intake, guiding food policy towards improved diets and lifelong health around the world.

Keywords: Food environments, Food systems, Diet costs, Diet quality

Conflict of Interest Disclosure: None

Further Collaborators: The Food Prices for Nutrition project is led by William Masters at Tufts University, with Anna Herforth (co-director) and numerous collaborators including partnerships with the World Bank (led by Nada Hamadeh and Marko Risannen), IFPRI (led by Derek Headey) and FAO (led by Cindy Holleman) as well as Yan Bai (World Bank and Zhejiang University).

SY(T9)4-2
Understanding expenditure patterns and choices in low-income households

Daryl Collins[1]

1. Decodis (USA)

Background and objectives. Low-income households not only earn little money but this money often comes into their households into their households in irregular streams, making it a challenge to meet daily needs as well as those across longer times periods such as a week or month, as well as expected seasonal needs and unexpected emergencies. The financial management choices of low-income households are geared not only to sustaining themselves in the present but planning for the longer-term in the context of irregular and unknown income flows.

Methods. Financial Diaries are a social research methodology which track the income, expenditure and financial management flows on a day-to-day basis for a year. This paper will draw from Financial Diaries from South Africa, Kenya, India, Pakistan, Mozambique, Tanzania and Mexico.

Results. Because many low-income households rely on irregular income flows from small business and farming, their financial management practices necessarily aim to be restrictive on a day-to-day basis in favor of ensuring money is available at a future time. Although nutritional intake is a daily imperative, low-income households also know that money must be set aside for other needs at other times. The type and amount of food is consumed therefore is not consistent day-to-day but can change dramatically depending on households' income patterns and how sure they are of income coming at a specific time in the future. Therefore, households can deliberately choose to spend

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

less than they could on food in favor of saving for emergencies, an opportunity or an important event in the future.

Conclusions. Dramatic differences in the amount and types of food that low-income people eat from day-to-day and week-to-week need to be taken into account when considering how best to understand and improve nutritional deficiencies within low-income households.

Keywords: financial diaries, food expenditure, income variability

SY(T9)4-3
Applying tools for estimating lowest-cost nutrient-adequate and healthy diets for the design of food assistance and social protection transfers

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1. World Food Programme (Italy)

Background and objectives. Cash, food and other income-type transfers are used for social assistance as well as food assistance to enable families to better meet their essential needs, including for food. The transfers may be packaged together with other goods and services aiming to achieve specific purposes such as women's empowerment, preventive health care coverage, prevention of malnutrition, school enrolment etc. We will share recent experiences of how the cost and affordability of nutrient-adequate diets were used to inform design of transfer packages, including setting transfer value as well as inclusion of complementary services, in different situations, to increase potential of these programmes to prevent malnutrition.

Methods. Data on availability and prices of foods from different food groups in local markets as well as food expenditure data were used to estimate the lowest possible cost and affordability of nutrient-adequate diets in Nigeria, Somalia and Kenya, and used to propose transfer packages for nutrition-sensitive food assistance for families in North East Nigeria, young children and pregnant and breastfeeding women at-risk of undernutrition in Somalia, and a nutrition-sensitive universal child benefits grant in Kenya.

Results. The lowest possible costs of nutrient-adequate diets were substantially higher than target population's food expenditure in all three countries, and it was not possible to close the entire affordability gap with cash/food assistance alone as the transfer value would have had to be much higher than what the programs could afford. However, based on the programs' goals, the information on local food availability and prices as well as other service delivery platforms that could reach the intended participants through their respective modalities, options to improve transfer design were proposed and scenario estimations for impact on cost and affordability performed.

Conclusions. Estimation of cost and affordability of healthy, nutritious diets for families as well as for specific target groups, coupled with information on what foods are available in their food environment, at what cost and on how they are spending their resources including on which foods, should be used to inform the design of nutrition-sensitive transfers for food assistance, prevention of malnutrition packages as well as social assistance.

Conflict of Interest Disclosure: The authors have no conflict of interest to report.

Keywords: social assistance, cash transfers, food assistance, prevention, nutrition-sensitive

SY(T9)4-4
Promoting Healthier Diets: A Practical Fiscal Policy Framework

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Motivation: The quality of the diet and the prevention of associated risk factors are topics of growing interest among actors interacting in health systems. Nutritional habits and lifestyles are closely related to health status and future exposure to certain types of non-communicable diseases. Improving health outcomes demands a shift to diets that comply with higher nutritional standards. Fiscal policies are tools widely used to encourage or discourage specific habits in the population, but not necessarily effective for all foods.

Objective: to present a comprehensive analytical tool for the design of an informed fiscal policy, in order to promote better alimentary decisions.

Methodology: The document defines each product based on three characteristics, which interact with each other: a nutritional quality measure; its estimated demand price elasticity; and the gap between actual and desired consumption. Measures of food quality are based on international definitions (GAPA: to promote, to limit and to discourage; and NOVA: fresh, processed, ultra-processed), applied to each food product present in the Argentine National Consumption Survey (ENGHo) produced by the National Statistical Institute, and own demand price elasticities were calculated (based on AIDS and Heckman approaches) to key food products. Moreover, consumption gaps provide information regarding the percentage deviation between the optimal and current diet followed by the population. Overall, the document introduces a three-dimension cube to analyze policy interventions.

Results: For Argentine households, we find that, by and large, the more unhealthy a food family, the more price elastic and, hence, targetable with taxes. Healthier food groups also reveal some degree of price sensitivity in their demand, which suggests that there may be some room for the introduction of subsidies to their price. At the same time, a third dimensional

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DOI: 10.1159/000530786

analysis identifies under and over consumption of certain products.

Policy implications: While taxes may reduce the consumption of low quality products, alternative interventions may be adequate for other parts of the food product space. In addition, the gap between current and ideal consumption serves as a reference for the intensity of the intervention.

Keywords: Public Health, Nutrition, Fiscal Policies, Demand Behavior

Conflict of Interest Disclosure: None

SY(T9)5-1
Improving the quality of child malnutrition data for SDG monitoring: mapping the unfinished research agenda

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Accurate data on child malnutrition is a key input for national governments and partners to develop and implement appropriate policies and programmes to address the nature and scale of malnutrition in their unique contexts. Height/length and weight are the most common anthropometric measurements used to define malnutrition. While seemingly simple, it has proven difficult to obtain accurate and precise measurements in population-based surveys and there have been concerns over the quality of these data. This precipitated the WHO and UNICEF to develop recommendations on the collection of anthropometric data in representative surveys. Using evidence-based information and expert experience, criteria and standards for collecting, analysing, and reporting malnutrition estimates were developed. The result has been remarkable progress in strengthening existing anthropometric measurement procedures and the adoption of new procedures in large-scale surveys, which has been shown to improve the quality of anthropometric estimates. Yet, there are many questions still to be answered. To advance this effort, the WHO-UNICEF Technical Expert Advisory Group on Nutrition Monitoring (TEAM) formed an Anthropometry Working Group to set a global research agenda. Based on a collaborative, iterative consensus-development process the group identified nine research topics: 1) definition and use of biologically and statistically derived anthropometric z-score flag values, 2) thresholds for anthropometric data quality indicators, 3) making the standardization process easier to administer during training, 4) identification and disentanglement of random and systematic error, 5) accuracy of collecting a single versus multiple height/length measurements, 6) minimizing the impact of hair and clothing obstruction in height/length and weight measurements, 7) best practices and value of conducting re-measurement during field work, 8) effective collection of age data to generate anthropometric z-scores, and 9) innovations in measurement equipment.

The release of briefs for each topic are planned on the research questions, type of research, primary and secondary outcomes, and data source with the intent of serving as a catalyst for addressing research in these areas. This talk will cover key research questions on anthropometric data collection in a survey context and offer insights on approaches to answer these questions. For anthropometric data to be beneficial to decision making, it is essential to increase engagement and investment in research on the 'how to' of collecting high-quality anthropometric data.

Keywords: anthropometry, data quality, implementation research, malnutrition, surveys

Conflict of Interest Disclosure: None

SY(T9)5-2
Meeting the measurement needs of the changing face of children's diets around the world

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Background and objectives: Indicators for assessing infant and young child feeding practices (IYCF) were published in 2008 with an accompanying operational manual released in 2010. In the years following their introduction, these indicators have been used to assess the status of and monitor progress in child feeding practices using data gathered mainly through large-scale surveys such as the Demographic and Health Surveys and the Multiple Indicator Cluster Survey. Following a decade of experience using the 2008 edition of the IYCF indicators, UNICEF and WHO organized technical consultations to revisit, refine and expand the set of recommended child feeding indicators, and released updated global guidance in 2021.

Results: Experience using the recommended IYCF indicators has raised some challenges related to definitions and operationalization. The updated global guidance addresses the issues highlighted during the technical consultations by revising the definitions for five out of the 15 previously existing indicators, excluding four indicators published in the 2008 guide from the 2021 edition due to challenges related to their interpretation, communication and operationalization and adding seven indicators that better measure the changing face of children's diets. For example: a major issue was that the minimum dietary diversity indicator, as defined in 2008, did not count breast milk as part of the diet diversity food groups while counting formula and milk, which led to breastfed children showing up as having less diverse diets than their non-breastfed peers in many contexts. Despite specific instruction against

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

comparing breastfed and non-breastfed children in the previous guidance, experience showed that such comparisons were often made, which made assessment between breastfed and non-breastfed children unfair and inconsistent. To address this problem, minimum dietary diversity was revised to include breast milk as an additional food group. Another key issue was the lack of recommended standard indicators related to unhealthy feeding practices, which evidence suggested was a growing problem in many countries.

Conclusion: In total, the 2021 guidance has 17 recommended indicators, including the first ever global standard indicators to measure unhealthy eating practices. These indicators are key for supporting programmatic action and monitoring progress on IYCF at national and global levels.

Keywords: nutrition, infant and young child feeding practices, diets.

SY(T9)5-3
Advancing methods, metrics, collection, and use of data on nutrition intervention coverage at household level

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Coverage is generally defined as the proportion of the population who should receive a program, intervention or service that actually do receive it. It is a more proximal indicator of policy implementation than more distal outcomes including diet quality as well as micronutrient and anthropometric status. Many governments, implementing partners, donors, and advocates rely on periodic large-scale household surveys such as Demographic Health Survey (DHS) to monitor whether priority populations are equitably covered by nutrition policy actions. Administrative data also play a roll. Recent efforts to map the availability of coverage data for interventions included in national multisector nutrition plans across South Asia and West Africa identified multiple data gaps. This presentation highlights the progress that WHO-UNICEF TEAM and other initiatives are making to improve nutrition intervention coverage measurement across low and middle income countries (LMIC), while summarizing key research gaps and operational challenges that remain.

TEAM has supported multi-stakeholder efforts to develop new coverage indicators and advocate for their collection. The 2017 Global Nutrition Monitoring Framework highlighted gaps in infant and young child feeding (IYCF) counseling coverage. In 2018, new IYCF counseling coverage indicators were endorsed by TEAM and adopted in the global DHS-8 questionnaire which is used in more than 90 countries. Ongoing indicator development work aims to fill data gaps or improve validity of metrics for coverage of maternal nutrition interventions during pregnancy including the gradual transition from iron folic acid to multiple micronutrient supplements as well as for nutrition-sensitive social protection and other nutrition interventions outside of the health sector. Recent investments in administrative data, including release of a core nutrition module for DHIS-2, also help fill information gaps on who is being reached with IYCF counseling, growth monitoring and promotion and acute malnutrition treatment.

TEAM and others are also working to improve collection and use of coverage data in countries. Recent National Nutrition Information Systems guidance emphasizes the importance of defining common core indicators and developing national and sub-national data strategies with explicit budgets and financing plans to ensure data are available to meet decisionmakers' needs. Nigeria and India are two examples of countries that feature intervention coverage data on scorecards, dashboards and sub-national profiles for nutrition audiences. Finally ongoing work to develop flexible methods for assessing co-coverage and composite coverage across multiple nutrition interventions will further support the use of data for planning and implementation of multisectoral nutrition strategies in LMIC.

Looking ahead, more research and collaborative effort is needed to define indicators of implementation quality and effective coverage of nutrition interventions within and beyond the health sector. There is also need to address cost challenges of regular population-based data collection, working on innovations in mobile surveys and other innovative sources of information about who is being reached.

Keywords: intervention coverage, household surveys, equity, policy monitoring, nutrition informations systems

Further Collaborators: WHO-UNICEF TEAM Coverage Measurement Working Group.

SY(T9)5-4
The Healthy Diets Monitoring Initiative: toward the development of healthy diet metrics for national and global monitoring

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Unhealthy diets and the associated burden of disease are a concern worldwide, with many countries grappling with nutrition and health issues caused by co- existing undernutrition and overweight and obesity. Healthy diets are critical for achieving several Sustainable Development Goals and the World Health Assembly global nutrition targets. Yet, no dietary intake indicators have been adopted for tracking progress toward these

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

global targets in populations over 2 years old, and few countries routinely monitor their population's dietary intake to inform their own policies and programs. The limited availability and use of dietary data are due, in part, to the lack of consensus on which measures and indicators should be used to capture important components of healthy diets with validity across settings and populations. This lack of consensus dissuades countries and donors from investing in data collection and use, hampering the tracking of their progress towards improved diets.

In collective recognition of this challenge and the need for action, WHO and UNICEF, through their Technical Expert Advisory Group on Nutrition Monitoring (TEAM), have joined forces with FAO to resolve these issues and chart a way forward through the Healthy Diets Monitoring Initiative. The Initiative is guided by a Strategic Planning Group that includes the Nutrition Division Directors from the three UN agencies, as well as TEAM Co-chairs and Secretariat, the TEAM diet quality technical working group, and key donors. The presentation will summarize: 1) the goals and objectives of the Healthy Diets Monitoring Initiative, 2) components of a healthy diet to prioritize for global and national monitoring, 3) an overview of the relative strengths and weaknesses of a range of diet quality metrics and tools, 4) plans for future research and potential next steps for achieving consensus and engagement with the broad community of stakeholders who are concerned with the assessment and monitoring of healthy diets.

Keywords: Diet quality, Metrics, Measurement, Food consumption, Global

Further Collaborators: Mia Blakstad (University of South Carolina)

SY(T9)-6
Publishing and Peer Review / Fundamentals of Peer Review

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This symposium will focus on the key elements required when reviewing manuscripts for publication. With overviews on the peer review process explained by editors from leading journals, the panel will respond to attendee's questions related to manuscript preparation, peer review, responding to reviews, and working with journals to improve global nutrition communication and impact.

Keywords: peer-review, publications, journals, early career

SY(T9)7-1
What “Japan Nutrition” has achieved and how can it contribute globally

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Before the Meiji Restoration, during the modernization of Japan, the diet of most Japanese people was simple and suffered from many nutritional deficiencies. 150 years ago, Japan modernized its nation and introduced nutrition science to improve its undernutrition diet due to its traditional staple food bias. It also controls obesity and non-communicable diseases caused by westernization of the diet after high economic development, and maintains a healthy and long-lived country. The reason is that the government, universities, industry, and professional associations have collaborated to improve nutrition as a national policy.

After the war II, our country suffered from severe hunger and imported food from the USA. At that time, we purchased vehicles and used these vehicles to provide nutritional education in every corner of the country. The improvement of nutrition in Japan took place through both food distribution and nutrition education. The nutrition educational vehicles were not food trucks that distributed food, but a vehicle that was used for education and to promote nutrition. Nutrition education does not relieve hunger or provides good taste, but it was the seed for a lifetime of health and happiness. In the end, Japan nutritional improvement have changed the food policy of USA into a nutrition policy.

We have trained many nutritionists and dietitians who are nutritional professionals, and placed them in every place of society according to the nutritional polices. For example, dietitians have provided school lunches and nutrition education in schools, managed clinical nutrition and dietary therapy for the sick in hospitals and welfare facilities and promoted for workers through company cafeterias, restaurant, and catering industries. Today, the program of school lunch has become a place for comprehensive learning about agriculture, fisheries, labor, nutrition, cooking, health, manners, spirit, human relations, food hygiene, environment, and culture.

This Japan's century-long history of nutritional improvement has created a social environment where currently people can access healthy food and receive nutritional education, no matter where they eat. We created a healthy Japanese-style diet by appropriately mixing a traditional low-nutrition diet with a high-nutrition Western diet.

“Green recovery" has been called out as a post-corona reconstruction plan, and diets with low greenhouse gas emissions are being considered. The amount of greenhouse gases emitted by the Japanese from livestock is less than half of the global average by FAO. The reason why we were able to create a healthy diet with less environmental impact is that Japan has introduced and practiced nutrition while inheriting the traditional food culture that respects nature.

We call this unique Japanese approach to nutritional improvement “Japan Nutrition”, and we want to share it with the world and contribute to the solution of malnutrition.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Japan Nutrition, dietitian, nutritional polices, nutritional education

SY(T9)7-2
What has been done and should be pursued for Vietnamese nutrition system?

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In 2011, the National Institute of Nutrition, Hanoi Medical University and Ajinomoto group launched the Vietnam Nutrition System Establishment Project (VINEP) with the aim of developing, training and utilizing “messengers” who can deliver knowledge of accurate nutritional information and awareness of nutrition-related issues among Vietnamese citizens. The group set three steps of activities to achieve the purpose of VINEP that are: Step1) Establishment support of dietitian training course/education system, Step2) Establishment support of national nutrition-related laws/code and Step and 3) National wide expansion support of established nutritional systems. The results of VINEP that are: 1) The country's first dietician training course was established by ministry of education and training (MOET) at Hanoi Medical University (HMU) in 2013, and in 2022, there are 12 universities conducting dietitian training courses, 2) The sub-Vietnamese Dietetic Association (Sub-VDA) as a precursor of VDA was established by the Vietnam Nutrition Society in 2014, stimulating to establish VDA in 2019, 3) VINEP has also worked alongside the governments to provide regular nutrition-related workshops/symposium to determining the first legal occupational status of dieticians (job code, 28/2015/TTLT-BYT-BNV) by ministry of health (MOH) in 2015, 4) HMU produced the country's first qualified 43 dieticians in August 2017, with the advocacy activities of VINEP, 5) The regulation of one dietitian pers 100 beds in hospital was approved by government (Circular 18/2020/TT-BYT stipulating nutritional activities in hospitals issued by the Ministry of Health) and VINEP continuously drives to establish more advanced nutritional systems for “nutrition standard” to help dietician actual activity. Through the improvement of infrastructure to convey accurate nutritional information through the enhancement of a nutritional system, VINEP contributes to raise and disseminate accurate nutritional knowledge to the whole country. Through such efforts, dieticians who have acquired proper knowledge of nutrition will help Vietnamese citizens improve their nutrition on their own initiative. Future plan of VINEP: 1) Establishing more advanced nutritional systems for “nutrition standard”, 2) Strengthening existing VDA, 3) Cooperation with multisectoral, public and private partners to develop and implement of school nutrition project that combines school lunch and nutrition education at elementary schools in Vietnam.

Keywords: VINEP, Nutrition system development

SY(T9)7-3
Meaning of VINEP in global nutrition contexts

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1. Konan Women's University (Japan)

In 2011, Ajinomoto Co., Inc. launched “Vietnam Nutrition System Establishment Project (VINEP) ”with the National Institute of Nutrition of Viet Nam, and four years dietitian training course was started at Hanoi Medical University in 2013. The Japan Dietetic Association, Jumonji University, Kanagawa University of Human Service, and others cooperated in the projects, and the first 43 dietitians were fostered in Viet Nam in 2017. In 2022, there are 12 universities conducting dietitian training courses in Viet Nam. Furthermore, the Ajinomoto Foundation has been continuing this project since 2017, and supporting the creation of a sustainable education system that will enable dietitians to play an active role. The results of VINEP that are: 1) the dietitian training course has been established. 2) the job code has been established. 3) the Vietnamese Dietetic Association (VDA) has been established. 4) the regulation of one dietitian pers 100 beds in hospital was approved by government. In order for the newly fostered dietitians to play an active role in improving the health of people in Viet Nam, the nutrition education system still needs to be improved. In countries where nutrition education systems have not been established, establishing a nutrition education system and taking on the roles of maintaining and promoting the health, preventing and treating diseases, and preventing nursing care of the people will greatly contribute to improving in global nutrition contexts.

Keywords: VINEP, Nutrition education system, global nutrition contexts

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DOI: 10.1159/000530786

SY(T9)7-4
Trial of school nutrition program in Vietnam

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The double burden of malnutrition is emerging as a health and nutrition challenge in Vietnam. Obesity, energy and micronutrient deficiencies have been reported in school-aged children. Childhood obesity needs to be corrected as it leads to later obesity, both physiologically and behaviorally. In addition, energy, protein, and micronutrient deficiencies during childhood may lead to stunting of growth and development and need to be corrected. Nutritional interventions for school-aged children include school lunches. School lunches are being introduced around the world because of their strong points of direct provision of food, which ensures the effectiveness of nutritional interventions, motivates parents to send their children to school to receive an education, and activates local agriculture. On the other hand, the nutritional benefits of school lunches have been considered to address energy and nutrient deficiencies. However, it has not been considered as a solution to the problem of obesity. Japan's school nutrition programs are unique in that they integrate school lunch and nutrition education. This may contribute not only to nutritional deficiencies, but also to improving children's knowledge, attitudes, and skills, and to improving obesity through behavior change. Therefore, with the aim of improving the double burden of malnutrition, the Vietnamese-Japanese team has initiated a trial of a Japanese-style school nutrition program in Vietnam in 2020, which will include the development of nutrition education programs and teaching materials, along with a review of school lunch menus. Online training was provided to Vietnamese dietitians. The menu pattern for school lunch is a combination of a staple meal, a side dish of meat, fish or egg, and a side dish of vegetables. A Vietnamese healthy plate was created to show the appropriate amount. The KAP model was used for the nutrition education intervention, and instructional plans and materials were developed for nine topics, including quality and quantity of a meal, quality and quantity of snacks, importance of breakfast, exercise and hand washing. Methods for monitoring leftover food surveys, survey design for effectiveness testing, and survey instruments were developed. The program has since been suspended due to the spread of the COVID-19 infection, but is scheduled to resume in 2022.

Keywords: school nutrition program, double burden of malnutrition, Vietnam.

SY(T9)7-5
Experiences to education for primary pupils on Japanese Nutrition

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Childhood nutrition practices may have a positive impact on nutrition behavior in adulthood. School nutrition programs, coexistence of school lunch and nutrition education, are effective for behavior change and nutritional status. The research will be carried out in September 2022, in order to apply the Japanese school nutrition model in Vietnam, include school lunch and nutrition education. The specific objectives of this study examine effects of school lunch and nutrition education on the knowledge, attitude, behavior (KAP) and nutritional status of school children, and on KAP of parents. This study will investigate the benefits of the school nutrition program and then spread to other parts of Vietnam. The study will be carried out in 02 primary schools, in urban and rural areas. School meal interventions and nutrition education communication will be part of the research. Nutrition education will be conducted for 2 months and include 8 lessons based on the Japanese Nutrition Education Programs. The following are the contents of the eight lessons: 1. A healthy meal 2. Grains group 3. Vegetables group 4. Main dish 5. Breakfast 6. Snacks 7. Exercise 8. Hand washing The study was able to assess the impact of nutrition education and school lunch on both parents' and children' KAP as well as their nutritional status. As a result, it is possible to introduce changes that are relevant to Vietnam and intervene in a broader manner.

Keywords: Nutrition, School nutrition programs, Nutrition education

SY(T9)7-6
Application of Japanese model on school nutrition in Vietnam

Huy Quoc Ly[1], Tri Ngoc Ta[1], Huy Do Nguyen[2], Nobuko Murayama[3], Yasuhiro Kido[4], Nhung Trang Nguyen[2], Kei Kuriwaki[5]

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Vietnam is updating primary school curricula and textbooks in order to help students develop physically and mentally; traits and capacities; self-awareness, family, and community values; study and living habits. For primary school students, health care

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

knowledge and skills are integrated in all subjects, especially Physical Education is the first goal. The focus is on equipping students' health care knowledge and skills. Knowing and implementing some basic requirements of integrated nutrition at the beginning of physical education lessons is one of the competencies required in elementary school students. 5th grade students need to have knowledge of " Exercise Nutrition ". However, the teaching of nutrition for primary school students currently faces many difficulties. PE teacher and general teachers have had knowledge of nutrition, but do not have a curriculum suitable for primary school students. After participating in the study on the application of 8 nutrition lessons for students based on the Japanese school nutrition program at 02 schools in 02 provinces in Vietnam. We recognize that this approach, if implemented in Vietnamese primary schools, will be an effective solution to help Vietnamese primary children gain health-care knowledge and skills. In the near future, we hope to carry out this research model in 5 provinces (with 2-3 districts each) representing the Regions in Vietnam. The next phase is to develop the model, submit it to the national scientific council for approval, provide a recommendation to the Ministry of Education and Training (MOET), organize training for teachers and guide the application of the results of this study. The output of this partnership is Vietnam's school nutrition program.

Keywords: Nutrition, School nutrition programs

SY(T9)7-7
Application of Japanese model on school nutrition in Vietnam

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1. Ministry of Education and Training (MOET) (Viet Nam), 2. National Institute of Nutrition (Viet Nam), 3. University of Niigata Prefecture (Japan), 4. The Japan Dietetic Association (Japan), 5. Ajinomoto Foundation (Japan)

Vietnam is updating primary school curricula and textbooks in order to help students develop physically and mentally; traits and capacities; self-awareness, family, and community values; study and living habits. For primary school students, health care knowledge and skills are integrated in all subjects, especially Physical Education is the first goal. The focus is on equipping students' health care knowledge and skills. Knowing and implementing some basic requirements of integrated nutrition at the beginning of physical education lessons is one of the competencies required in elementary school students. 5th grade students need to have knowledge of " Exercise Nutrition ". However, the teaching of nutrition for primary school students currently faces many difficulties. PE teacher and general teachers have had knowledge of nutrition, but do not have a curriculum suitable for primary school students. After participating in the study on the application of 8 nutrition lessons for students based on the Japanese school nutrition program at 02 schools in 02 provinces in Vietnam. We recognize that this approach, if implemented in Vietnamese primary schools, will be an effective solution to help Vietnamese primary children gain health-care knowledge and skills. In the near future, we hope to carry out this research model in 5 provinces (with 2-3 districts each) representing the Regions in Vietnam. The next phase is to develop the model, submit it to the national scientific council for approval, provide a recommendation to the Ministry of Education and Training (MOET), organize training for teachers and guide the application of the results of this study. The output of this partnership is Vietnam's school nutrition program.

Keywords: Nutrition, School nutrition programs

SY(T9)8-1
Building capacity to scale-up improved inpatient treatment of severe malnutrition: experiences of South Africa

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Background and objectives: As a middle-income country, South Africa reported that 27% of children under 5 years are stunted and 15% are underweight. Ten-percent of under-5 inpatient admissions were severely malnourished (SAM), contributing at least two-thirds to in-hospital death rates. South Africa embarked on a national program to scale up the WHO 10-Steps Guidelines (WTS) using quality improvement approach from 2008 when inpatient case fatality rates (CFR) were as high as 20%. We describe the approach we took to half the national CFR between 2008 and 2021.

Methods: We reviewed the routinely reported inpatient admissions and deaths data from 2008, and evaluated the impact of multidisciplinary healthcare worker training, building systems and changing care processes at all levels of care, with a focus on improving quality of inpatient care. We applied a 'whole system' accountability approach and developed 'ways of governing' and supporting facilities to overcome implementation challenges. We also developed standard treatment guidelines, job aids and monitoring and evaluation tools for facilities to use and report against.

Results: In 2008/9, there were 12,028 admissions and 2,311 deaths (CFR of 19.2%) to inpatient units reported across the country. Between 2008 to 2012, training on the WTS were conducted, followed by intensive continuous provincial and district level technical assistance, frequent data reviews and focus on ensuring high levels of clinical and systems reliability in care of SAM inpatients between 2012 and 2017. Facility improvement teams also reported their monthly performance at organised district management teams review meetings. Currently, all inpatient facilities admitting SAM cases were implementing the WTS. There has been a steady decline in the CFR from 2009 (19.2%) to 7% in 2021, with both numbers of

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

admissions (8,093) and deaths (568) decreasing during observation period.

Conclusions: The traditional approach to reducing CFR by changing clinical practices through training and "pushing" principles of adherence to WTS is a necessary step but not sufficient to achieve sustained improvements we have observed. Adding a layer of accountability ("ways of governing") and continuously reviewing the performance at facility level ensures a supportive environment to institutionalise the recommended care practices.

Conflict of Interest: Disclosure

Further Collaborators: None

Keywords: Severe Acute Malnutrition, South Africa, WHO 10-Steps, Case fatality rate, Quality improvement.

SY(T9)8-2
Building capacity to scale up improved inpatient treatment of severe acute malnutrition in Bolivia

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Background and objectives: Severe acute malnutrition (SAM) remains a current issue in many parts of the world, undermining young children's well-being and survival. Bolivia has adopted an integrated management approach for SAM recommended by UN organizations; this includes early identification and treatment in primary health facilities. However, inpatient care is needed for severely ill children with life-threatening complications. Bolivia was an early implementer of the World Health Organization (WHO) guidelines for inpatient management of SAM. Implementation started as a pilot, and the immediate reduction in mortality helped the guidelines to become established within the health system, and be scaled-up nationwide. The presentation will describe the steps used in Bolivia to build capacity for implementing and scaling-up the WHO guidelines across the country, factors that contributed, and limitations encountered in the process. **Methods**: Qualitative and quantitative data of case management in health facilities were reviewed, along with staff reports, findings from workshops, supervisions, and published papers related to implementation. The review was complemented with structured interviews with key actors working in primary care and hospital settings to fill gaps. **Results**: The WHO inpatient guidelines for SAM were implemented successfully in Bolivia's National Health System after an initial application which demonstrated reductions in case fatality rates from around 25% initially to 5-7%. Building capacity and scaling up was possible through political commitment and a support network of policy makers, academic institutions, and scientific societies. Data analysis showed: i) adoption of the guidelines by designated hospitals, ii) availability of appropriate supplies to manage SAM, iii) reduction of SAM cases, and iv) continuation of low case fatality rates.

Conclusions: Capacity to implement and sustain WHO inpatient SAM guidelines in the entire health system involved many steps, complex logistics, and the support of policy makers, academia, and scientific societies; the logistics needed for sustainable management must be embedded in the health system's structure and budget.

Conflict of Interest Disclosure: I declare no conflict of interest

Keywords: capacity building, malnutrition treatment

SY(T9)8-3
Building capacity to Scale up improved inpatient treatment of severe malnutrition: experiences of Malawi

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Community-based management of Acute Malnutrition has been successfully implemented in Malawi since 2002. However, the bottleneck to the efficient programme delivery has been poor quality of care for children with severe acute malnutrition admitted in the inpatient care units. Ministry of Health with support from partners has been addressing malnutrition challenges through integration of CMAM into routine health services, multi-sectoral approach to dealing with the challenges and quality improvement in the inpatient care unit for severely malnourished children. The Malawi experiences details actions taken by the Ministry to improve quality of care through training and supportive measures. To improve quality of care the Ministry with support from partners implemented a cascade of activities. After the review of CMAM Guidelines in 2016, the Ministry set up a team of Master Trainers in Inpatient Care who were trained by Region WHO Trainers for Inpatients Care. These master trainers were responsible for training and setting up National Trainers. So the National Trainers have been providing capacity building support to 104 inpatient care units in the country. Each of the 104 Inpatient care Unit has facility-based mentor who provides technical support when required. The Ministry also introduced Quality Improvement (QI) approach. Each district identified factors associated with high mortality and set up strategies to improve quality of care and Programme outcomes. The QI Approach the inpatient care facilities were able to systematically identify problems and causes of the high death rate and develop priority solutions to improve case management. During the period of the intervention, the Ministry observed improvement in 5 aspects of children with severe acute malnutrition management especially in 7 health facilities which had case fatality rate of over 10%. These aspects include; assessment of medical and nutrition complications which was at 94.6% after 17 months of implementation from a baseline of 23%. Prevention of dehydration was at 95.8% from 20.6%. treatment of dehydration was at 92.9% from 14.1%. Cautious

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

feeding was at 94.7% from 26.7% and finally death audits within 72 hours of death from 0% to 50% in the 17th month of quality improvement approach. Through the training of Health Service Providers, the Ministry was able to build confidence in service deliver and controlled the death rate to less than 10%. Other underlying causes of high death rates in the inpatient care such as late presentation, mismanagement of emergency cases in the outpatient section and inadequate availability of essential supplies and equipment need to be resolved.

Keywords: Malnutrition, Inpatient, Training
Conflict of Interest Disclosure: No conflict of interest.
Further Collaborators: No further collaborators

SY(T9)8-4
Building capacity to scale-up improved inpatient treatment of severe malnutrition: experiences in Ghana

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Background: Scaling up management of severe acute malnutrition (SAM) using the WHO guidelines has a very great potential to reduce child mortality, but it requires improved operational capacity in LMICs. The malnutrition eLearning developed by University of Southampton and the IMTF provided an opportunity for SAM management scale-up, and support for its integration into curricula was seen as an added opportunity for continual utilization of the course.

Objective: We describe the identification and training of educators/trainers of pre-service institutions and the impact on course utilization and integration.

Methods: A survey was conducted of 11 pre-service health institutions to assess prior teaching on malnutrition and utilization of eLearning in teaching, and 22 trainers/educators were invited to a two-day workshop. Pre-workshop questionnaire assessed current teaching and opportunities for eLearning integration. During the workshop, actions plans for course integration were developed by each institution. Follow-up for 12 months was used to evaluate the utilization of the course and its integration into the curriculum at the institutions.

Results: Pre-workshop, only 2 of the 11 academic institutions used eLearning for teaching, and teaching on malnutrition was superficial. Workshop participants described what health professionals should know and be able to do regarding SAM; their roles as educators in achieving this; gaps in current teaching on SAM; challenges of face-to-face training of existing and future health professionals, and how the malnutrition eLearning could help address these gaps. Educators were equipped with skills and techniques for integrating the course, which included taking the malnutrition eLearning course themselves, creating awareness of the malnutrition eLearning course, engaging with institutional managers on course integration, reviewing existing curricula, and integrating the course into teaching/training. All 11 institutions developed action plans for integration. At the 12-month follow-up, 6 institutions had integrated the malnutrition eLearning into their existing courses, 1 reported that curriculum integration was in progress and 1 institution was using aspects of the course for teaching. Currently, all 11 institutions use the course.
Conclusion: The workshop created awareness for eLearning in teaching, and equipped educators on integrating malnutrition eLearning into teaching and curricula, and improving course utilization.

Keywords: Malnutrition eLearning, Severe Acute Malnutrition, Ghana, Pre-service institutions

Conflict of Interest Disclosure: Sunhea Choi and Reginald A. Annan co-authored the malnutrition eLearning course. Ann Ashworth reviewed the course.

SY(T9)9-1
Redefining concepts and methods for nutrition sciences. What sets it apart from medical sciences?

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Background and objectives: The Federation of European Nutrition Societies (FENS) has established three working groups on the topic of improving the standards of nutrition. Working group 1, which is composed of 28 nutrition scientists across Europe, focuses on concepts and methods and takes as a starting point that nutrition science is about the *maintenance of health*, and not just about the prevention of disease. This raises challenges in issues of: cause and effect; hierarchy of evidence; the use of biomarkers, and participatory approaches. The objective is to contribute to the debate about why and how concepts and methods for nutritional sciences are different from concepts and methods used in medical sciences.

Methods: We chose five exemplary topics to illustrate what sets nutrition sciences apart from medical sciences by doing scoping reviews based on Web of Science, Scopus and Pubmed assuring a wide range of perspectives from both the natural and social sciences.

Results: The five examples are: (1) Sugar and quality of life; (2) Vitamin D and cardiovascular diseases; (3) Vitamin D and COVID-19; (4) Failure to adhere to dietary interventions; (5) Overweight prevention in low SES populations. Examples 1 and 2 provide an in-depth exploration of both clinical and community-based epidemiological studies to provide guidance for the design of

future similar studies. Example 3 concerns the ranking of papers based on their statistical approach and the construction of a statistical model followed by both internal and external validation. Example 4 focuses on observational studies and will contribute to our understanding of why we may miss effects of an intervention because of poor compliance. Example 5 specifically explores the added value of participatory approaches as a bottom-up approach that gives voice to those who have not been heard, and is thus well suited for marginalised individuals or population groups.

Conclusions: At the conference a synthesis of the above-mentioned examples will be presented as well as a recommendation for concepts and methods in nutrition science tailored to better address the current complexities in nutrition challenges in clinical and societal applications.

Keywords: concepts, maintenance of health, cause and effect, hierarchy of evidence, participatory approaches

Conflict of Interest Disclosure: The authors declare no conflict of interest.

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SY(T9)9-2
How can the credibility of nutrition science be improved? An update of FENS-WG2

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1. Umeå University (Sweden), 2. Università di Bologna (Italy), 3. University of Bergen (Norway), 4. University of Turku (Finland), 5. University of Southhampton (UK), 6. De Vries Nutrition Solutions (Netherlands), 7. Nutricom (Netherlands)

Background and objectives: The Federation of European Nutrition Societies (FENS) has organised three working groups to improve the standards of the Nutrition field. Working Group 2 (WG2) deals with organisation, capabilities and funding. The field of nutrition has faced issues of credibility due to contradictory messages often resulting from financial conflicts of interest. WG2 require an in-depth evaluation of how funding affects nutrition education and as result, how the field is currently organised, often in complex relation other disciplines. Hence, it addresses how nutrition science is communicated within the scientific world; and, how it can better recognize and deal with conflicts of interest resulting of interactions with different stakeholders, including industry.

Objective: To report on the progress of WG2, with focus on how nutrition educations in EU and the funding opportunities interplay in shaping nutrition research and science, and how both can contribute to improving the credibility of the discipline.

Methods: Qualitative approach in two phases a) Inventorying of educations and funding landscape for nutrition in EU and beyond through desk research in 2021; and b) Refining education and funding through questionnaires sent to FENS members. **Results**: WG2 developed a framework of definitions for nutrition science, research, education and promotion. Nutrition is an integrative science that bridges disciplines and actors through the food chain. The focus and methodologies of nutrition education varies between and within EU countries, as it is integrated in disciplines from medicine to agriculture. Public funding is not always clearly addressed to nutrition, as it is part of larger disciplinary calls. Industrial funding is frequently from very large companies, while SMEs appear not to have the funds for nutritional research. Funding influences the orientation of research-based nutrition education. Positive interactions with industry are facilitated when third parties are involved e.g. EU funded projects.

Conclusions: Nutrition education is offered within disciplines e.g. medicine, food technology, dietetics, sociology or agriculture, and has a different meaning for each. Common definitions for nutrition science, research, education and promotion will facilitate communication within the scientific community. Funding strengthens the researchers who benefit from it shaping their teaching, research output and societal impact. Public funding should catalyse healthy academia-industry interactions to overcome the risk of financial conflicts of interest and improve the credibility of nutrition science.

Keywords: FENS, Nutrition funding, Financial conflict of interest, Nutrition education

Conflict of Interest Disclosure: None

Further Collaborators: Ilona Faber, Sarah Brennan, Masenjka Katic, Igor Spiroski, Kirsty Pourshahidi, Aletta Kraneveld, Yves Morel, Gregorio Varela

SY(T9)9-3
Building trust - tools to enhance nutrition science communication

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Background

The third working group of FENS, which is composed of twenty nutrition scientists across Europe, has been charged with establishing a series of guidelines and recommendations for European wide implementation to assure and promote public trust in nutrition science.

Objectives

A clear issue with the credibility of nutrition science has been identified with public confusion and distrust generated by a lack of clarity and transparency when publishing nutrition science research. There is an urgent requirement to review the current communication process for nutrition research to clearly and accurately summarise the findings and highlight their impact, in the context of current public health nutrition guidance, to ensure this research is credible and relevant to a public audience.

Initiatives This working group has focused on two main initiatives. Firstly, an evaluation of the CONSORT statement as it relates to nutrition trials. The Statement details the minimum requirements for reporting RCTs, however, there is currently no nutrition-specific guidance, and it remains unclear whether such guidance is warranted to improve reporting in nutrition. We have assembled an international and geographically diverse committee of experts across a range of nutrition trial domains. Sixteen of the 25 CONSORT items have thus far been identified to potentially require additional guidance when reporting nutrition RCTs. Secondly, the working group has focused on the production of a detailed series of guidelines for writing and reviewing press releases. Research has identified that many of the inaccuracies in mainstream reporting stem from the original press release and these guidelines aim to address these concerns.

Conclusion

For the first initiative, the work will be peer-reviewed and results mapped and presented in an opinion piece for publication in the scientific press. The guidelines for reviewing and writing press releases will be presented together with recommendations for other potential initiatives to support and promote public trust in nutrition science

Conflict of Interest Disclosure] None

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Keywords: Nutrition Trials, CONSORT, Reporting, Public Health Communication

SY(T9)10-1
Writing Your Research Paper and Selecting the Right Journal to Submit Your Work

Teresa Davis[1], Katherine Tucker[2], Christopher Duggan[3], Jack Odle[4]

1.Baylor College of Medicine (USA), 2. University of Massachusetts Lowell (USA), 3. Boston Children's Hospital (USA), 4. North Carolina State University (USA)

Research needs to be disseminated to broaden scientific knowledge and improve health. Scholarly publishing also advances a scientist's career, boosts future funding, and fosters transparency in the research process.

In this session, the American Society for Nutrition's Editors will share insights on getting research published in leading journals. Findings need to be published in the most appropriate journal to reach the target audience. Other factors to consider include journal impact factor, speed of publication and costs. Authors are encouraged to choose influential journals in the field, so that they get the most rigorous peer-review as this process always strengthens a manuscript and builds trust in science. Being aware of predatory journals is imperative as these journals continue to proliferate. Common tactics of predatory journals include use of deceiving titles similar to established journals; exploitation of the open access model for profit; and omission of common services such as peer review, editing and content indexing.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Types of scientific writing include systematic reviews and meta-analysis; original research articles including clinical studies (e.g., randomized controlled trials, cohort studies) and animal studies; case series/reports; and perspectives.

Resources are available to assist authors with manuscript preparation. The International Committee of Medical Journal Editors (ICMJE) guides authors on ethical considerations and preparation of manuscripts and uniform requirements. The ICMJE's well-established criteria help ensure an efficient peer review process. Other resources include the CONSORT Guidelines for reporting clinical trials; PRISMA for systematic reviews and meta-analysis; ARRIVE guidelines for animal studies; and STROBE that aids reporting of observational studies.

Finally, all authors benefit by fully understanding the peer review process. Quality, stringent peer review is the cornerstone of scholarly publishing. After a preliminary assessment to ensure that the work fits within a journal's scope, a manuscript is assigned to an associate/academic editor who selects peer reviewers and oversees the review. This individual will evaluate revisions, if needed, and make recommendations on acceptance or rejection. Within ASN journals, peer review is anonymous, and a statistical board review is available to consult on methods and analysis.

Authors should follow the reviewers' advice and respond graciously and respectfully. Respond to all reviewers' comments and clearly identify revisions made. If a manuscript is not accepted, don't despair. Take the feedback gained and revise the manuscript for another journal. Within the ASN journal portfolio, it is not uncommon for manuscripts to be transferred to another journal that may be a better fit or provide another opportunity for consideration after revision.

Keywords: scholarly publishing, journals, peer review, predatory journals

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Keywords: scholarly publishing, journals, peer review, predatory journals

SY(T9)10-2
Understanding the Peer Review Process and Responding to Reviewers

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Research needs to be disseminated to broaden scientific knowledge and improve health. Scholarly publishing also advances a scientist's career, boosts future funding, and fosters transparency in the research process.

In this session, the American Society for Nutrition's Editors will share insights on getting research published in leading journals. Findings need to be published in the most appropriate journal to reach the target audience. Other factors to consider include journal impact factor, speed of publication and costs. Authors are encouraged to choose influential journals in the field, so that they get the most rigorous peer-review as this process always strengthens a manuscript and builds trust in science.

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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T9)11-2
Innovative Financing for Nutrition: Is there a business Case?

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Malnutrition in all its forms, including undernutrition, obesity and other dietary risks, is the leading cause of poor health, lost productivity and lost human capital. Malnutrition is not only a major component of health, human development, and human security, but is further compounded by climate change through sustainable food systems. There is general consensus to create a focus on common systemic drivers that need common actions, and sustainable and health-promoting business models. However, only the climate change agenda has gotten traction and financing at scale from the global community. Nutrition remains a relative orphan with modest global traction from the public sector (primarily for the undernutrition agenda), and almost no traction from the private sector, for either undernutrition or obesity. Though recent events such as the "Nutrition-for-Growth" (N4G) summit hosted by the government of Japan in December 2021 have led to a commitment of nearly $30 billion for nutrition and food security, it is still unclear how many of these commitments will translate in to action on the ground. This symposium will focus on the recent efforts which aim to maximize available resources for nutrition through innovative financing, in tandem with maximizing the impact of available financing: "More Money for nutrition, More nutrition for the Money" across the globe.

Keywords: Innovative financing, Nutrition, Domestic financing, Business case

Conflict of Interest Disclosure: None

SY(T9)12-1
Introduction of Cochrane systematic reviews in nutrition

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To promote health and well-being not only in clinical practice but also in society, the development of reliable and validate evidence is essential. Cochrane was established in the early 1990s and delivers high-quality information to guide the decision-making process on health-related matters. Cochrane primarily provides evidence from Cochrane Systematic Reviews. These reviews systematically summarize the results from existing studies and assess the certainty in the evidence following the Cochrane guidelines. The Cochrane Library currently contains over 7,500 systematic reviews, which are used in various medical fields. Cochrane has also played a central role in developing new methods of evidence synthesis. The presenter is an active Cochrane member, author and instructor, and will introduce the methodology for producing Cochrane systematic reviews and overview reviews using nutrition-related examples.

Keywords: Systematic reviews, Cochrane, evidence, nutrition

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T9)12-2
Food Environmental Intervention: A Systematic Review

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The prevalence of non-communicable diseases is a global issue, and many studies are being conducted in the field of public health nutrition to formulate strategies for health management and the prevention of non-communicable diseases. A shortage of vegetables and fruits and excessive consumption of fats and sugar can lead to chronic diseases. A few countries, such as Mexico and the United Kingdom, have implemented national policies that impose a tax on foods with excessive amounts of sugar (sugar tax). These countries recommend a reduction in the purchase of these foods and encourage the consumption of healthy foods. Incentives (i.e., price reductions for healthy foods and introduction of point systems in supermarkets and cafeterias) have been promoted, in addition to national policies. We conducted a systematic review using the Cochrane method to identify the impact of such pricing strategy incentives as food environment interventions on consumer eating behaviors and health outcomes. In this symposium, we will introduce the promotion process and features of the systematic review, as well as difficulties in conducting a systematic review using the Cochrane method.

Keywords: Food Environmental Intervention, pricing strategy, systematic review method, process

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T9)12-3
Economical analysis of fruit and vegetable intake in Japan

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This study aimed to project the reduction in the CVD burden under different scenarios of increased fruit and vegetable intake in Japan by 2060. Based on Monte Carlo simulations projecting disease burden attributable to different scenarios of fruit and vegetable intake patterns by sex and age, the study suggested that a relevantly large percentage of the CVD burden can be alleviated by promoting even modest increases in fruit and vegetable consumption in Japan. As the results, across all age groups, men had a higher daily vegetable intake than women but a lower daily fruit intake. Comparing with recommended intake level, the total CVD burden was estimated to be 302,055 DALYs attributable to inadequate fruit consumption in 2015, which accounted for 12.6% of the total CVD burden. In 2060, the percentage of the CVD burden due to insufficient intake of fruit is estimated to decrease to 7.9% under the moderate increase scenario and to decrease to 4.5% under the high increase scenario. The study provided an example of projected health and economic impacts of nutritional interventions.

Keyword: Economic analysis, disease burden, vegetable, fruit

Conflict of Interest Disclosure: N.A.

SY(T9)13-1
A global overview of the state of food composition, with a focus on challenges for dietary surveys

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1. Food and Agricultural Organization of the United Nations (FAO) (Italy)

Dietary assessment involves the collection of information on the quantity, and usually frequency, of foods and drinks consumed over a specified time. The calculation of energy and nutrient content of foods and drinks consumed in dietary surveys is performed using food composition tables (FCTs). The availability and use of good quality and up-to-date relevant country- or regional FCTs to convert food consumption into nutrient intake is critical. It is essential that FCTs are updated regularly to be representative of the foods available in a country, include new foods and drinks introduced on the market, and to update the nutritional value of foods and drinks that may have changed in composition over time e.g. as a result of changes in manufacturing processes or reformulations due to government health initiatives.

Many countries have their own national FCTs, although they are of varying levels of quality and completeness. According to recent evaluations made by FAO, more than 100 countries have already published at least one FCT, however many countries, including many low- and middle- income countries, still have no published food composition data. Published FCTs vary a lot in terms of quality, coverage, documentation, accessibility and frequency of updates. Around half of available FCTs were last updated more than 10 years ago.

By combining dietary survey data and food composition data it is possible to determine whether or not the diet is nutritionally adequate. Many conditions need to be met to link dietary survey data with food composition data effectively and correctly. The FCT must be selected carefully, considering quality and relevance (year, country, language), method and quality of data analysed or collated, but also availability and access. The completeness and relevance of the food list must be considered, together with reliability (e.g. percentage of items with missing values) and the list of nutrients that can be reported. Interviewers must be very familiar with both the local diet and the FCT to be used, in order to probe subjects effectively and obtain adequate detail for subsequent coding and transformation of data into estimated nutrient intakes. The matching of food items to the appropriate code or codes in a food composition table is challenging and time consuming. The use of poor quality FCTs may introduce error into the estimates of energy and nutrient intake which may impact on prevalence of nutrient inadequacies.

This presentation will highlight the global coverage and gaps of FCTs, highlight associated challenges in the linking of this data to dietary surveys, and provide updates on FAO's recent work in food composition.

Keywords: Food composition, Dietary surveys, Food consumption, Nutrient intakes, Dietary assessment

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T9)13-2
Unlocking Food's Comprehensive Biochemical Composition for Human and Planetary Health

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Globally, we are failing to meet multiple nutritional, health, and environmental targets linked to food. Characterizing food in its full biochemical and quantitative diversity is central to data-driven decision making for supporting human and planetary health. This presentation features efforts of the Periodic Table of Food Initiative, a participatory effort to create a globally shared data resource on food's comprehensive biochemical profiles to complement existing food composition efforts. We performed a baseline experiment to assess variability of analytical approaches across laboratories in order to understand challenges and opportunities of evaluating food biochemical profiles. Twelve standard reference food samples were provided to three established metabolomics laboratories representing a range of food types (apple, banana, tomato, lettuce, carrot, onion, spinach, potato, soybean, beef, cow's milk, and chicken egg). Each lab analyzed provided samples using their established analytical approaches based on high-resolution LC-Mass Spectrometry and submitted: (i) results of detected and annotated compounds; (ii) normalized quantitative values and; (iii) details of their analytical methods. Results revealed that data were highly reproducible within laboratories while quantitative results were not comparable between laboratories due to low overlap of analyte identification. For example, a total of 927 named biochemicals were returned from the analysis of the standard reference apple sample with only 14 biochemicals reported by all three laboratories. Findings demonstrate that despite highly developed analytical technology, the data pipeline, annotation tools, and reagents are fragmented between laboratories, making cross-laboratory comparison difficult. This baseline study supports the need for the development of standardized methods, reagents, and a common data pipeline to populate a democratized global data resource for food biochemical profiling. We conclude with a snapshot of preliminary results from analyzing 100 foods using standardized methods, reagents, and a common data pipeline developed by the Periodic Table of Food Initiative.

Keywords: food composition, biochemical profiling, metabolomics, database, standardization

Further Collaborators: Periodic Table of Food Initiative Global Collaborators

SY(T9)13-3
Food Nutrition Cloud: concepts and developments in food data, tools and services for food labelling and reformulation in nutrition research

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Background and objectives: Existing food nutrition security (FNS) data, knowledge, and tools for agri-food sciences are fragmented, lack critical mass, and access is unevenly distributed. This means FNS data are not readily found, accessible, interoperable, or reusable (FAIR), and existing services focus on clinical and biological sciences. FNS-Cloud is developing the first-generation 'food cloud' by federating existing and emerging datasets and developing and integrating services to support re-use through the European Open Science Cloud (EOSC). This talk will introduce FNS-Cloud and explore some of the first outputs, FNS Data Map and Catalogue and focusing on existing (use cases) and emerging (field trials) data. Methods: Based on existing food datasets, two use cases will be presented. Firstly, we will explore between-country comparison of branded food data for research, nutrition surveillance and policy. The goal is to investigate differences in the nutritional quality of the food supply in four European countries (NL, SI, DE and CH) across selected food categories (non-alcoholic beverages, yoghurts, breakfast cereals). Comparison testing will include assessment of energy, sugar and fats, which are commonly targets for food reformulation, as well as overall food quality scoring, using nutrient profiling. Secondly, food labelling data has been also used to compare different tools to investigate different approaches for estimating contents of nutrients in processed foods. The goal is to estimate the wider micronutrient data that is missing on the food label. Results: Work is ongoing on identifying processes used, defining required outputs. Harmonised datasets have been prepared for selected branded foods and test results will be produced and improved in a stepwise manner. Procedures to evaluate performance, quality requirements and nutritional results from the tools are under construction. Conclusions: The use of harmonised food datasets combined with advanced ICT tools and services will facilitate better research and exploitation of knowledge as well as delivering training and support to boost confidence and build capacity amongst user communities to improve the sustainability of European food systems and further enhance existing strengths in FNS research. Acknowledgements: Food Nutrition Security Cloud (FNS-Cloud) has received funding from the European Union's Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3. – A sustainable and competitive agri-food industry) under Grant Agreement No. 863059 – www.fns-cloud.eu.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Food composition data, Food labelling, Reformulation, Nutrition, Public health
Conflict of Interest Disclosure: No conflicts of interest.
Further Collaborators: None.

SY(T9)13-4
Overcoming challenges in food matching

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Background: Food matching refers to the activity of linking food consumption or supply data with food composition data to calculate nutrient intake or availability. Food matching should aim for the highest quality match possible by identifying the most appropriate food in the most appropriate source of compositional data. This matching a critical and challenging step to obtain high quality estimations, considering that data from food consumption/availability and food composition tables (FCTs) describe and classify foods using distinct criteria and descriptors.

Objectives: To establish a systematic approach to match foods from the FAO Supply Utilization Accounts (SUAs) and food composition data from different FCTs and document the challenges.

Methods: To assist with the selection of the FCTs for use during the food matching, eight screening questions from the new FAO/INFOODS Evaluation Framework were used to assess the quality of the potential FCTs. Documentation from the selected FCTs was carefully checked to identify the components, units, denominators and number of missing values for each component. The FAO/INFOODS component identifiers (also called tagnames) were assigned for a more precise component identification. The main criteria applied during the food matching was performed according to the FAO/INFOODS Guidelines for Food Matching.

Results: A total of 29 FCTs were assessed but only 13 were considered eligible in terms of quality for the food matching. After the component evaluation, 20 components were considered for the first phase of the food matching including energy, edible portion, six minerals and four vitamins. Food matching included about 550 food items from the SUAs list, considering crops, livestock and fisheries. A quality criteria was assigned to each matching according to the FAO/INFOODS guidelines. Many challenges and limitations were identified, both in the list of SUAs items and in the foods listed in the FCTs, such as limited food description, lack of standardization for calculated components, food fortification, biodiversity, food processing, etc. Specific matching criteria was established on a food group or food basis and assumptions and limitations documented in detail. Some key examples will be presented and discussed.

Conclusions: Multiple challenges were overcome during the food matching, thus setting a systematic approach was critical, especially where tasks involved several professionals. The systematic approach matching foods from the SUAs to food composition data facilitated the development of a single global food composition table to access food availability data.

Keywords: Food matching, Food composition, FAO/INFOODS, Nutrient intake, Nutrient availability

SY(T9)13-5
Nutrient data needs and emerging issues of food composition databases

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The food composition database (FCD) is central to most areas of food, nutrition and health activities. Nevertheless, many countries do not even have their own FCD, and most of the existing ones were constructed using borrowed data from other countries and sources. There is also an acute lack of analytical data in most country FCDs due to the high cost and complexities involved in generating it. FCD is being used in many areas not well anticipated years back, and the demand for high-quality analytical data is increasing daily. The realization that nutrients can vary a hundredfold within the same food species has spurred the need for high-quality analytical nutrient data at variety, cultivar and breed levels for food crops. Such data is crucial for implementing nutrition-sensitive agriculture to promote the consumption of varieties or cultivars with higher nutrients or for crop biofortification to alleviate micronutrient malnutrition. Beyond nutrient diversity, the nutritional importance of dietary diversity is now widely recognized in addressing all forms of malnutrition. The potential of indigenous food crops, including wild foods, to improve dietary diversity remains largely unknown and underexploited. However, available evidence calls for systematic investigation as many potential indigenous foods can be the impetus for change and the starting point to mainstream it into the global food system. Attention to non-nutrient biologically active compounds in foods that may provide a health benefit beyond the traditional nutrients is growing. With newer and more sensitive analytical techniques evolving continuously, the science of human nutrition has enlarged to recognize the role of minute quantities of bioactive components in foods that modulate metabolic processes and reduce disease risk. Though only in minute quantities, the variety and content of biomolecules in foods are almost unexplored. The demand for high-quality analytical data on foods globally is urgent; investing in this area is crucial in terms of the potential to protect and improve public health nutrition over the following decades.

Keywords: Food composition database, Nutrient data, Biodiversity, Emerging issues
Conflict of Interest Disclosure: None
Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T9)14-1

Adolescent girls' and boys' micronutrient and anthropometric status in Nepal, Bangladesh, Ghana, Burkina Faso, Guatemala, and the USA

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Background: Despite recognition of adolescents aged 10-19 years as a population at-risk for malnutrition, there has been minimal population-based assessment of nutritional status of adolescents worldwide. Using data collected in the last decade, this presentation provides information on micronutrient and anthropometric status of adolescent boys and girls ages 10-19y from multiple geographic locations.

Methods: We analyzed data from national or sub-national micronutrient surveys and nutrition and health surveillance systems. Data were collected between 2012-2019 in Ecuador (2012), Ghana (2019), Guatemala (2017/2018), Great Britain (2014), Malawi (2015-2016), Mexico (2012), Nepal (2016), and the United States (2015-2018). We calculated prevalence of anemia based on hemoglobin (Hb) adjusted for altitude and/or smoking (Hb < 115 g/L for adolescents < 12years, <120 g/L for 12–14y and girls 15y+, and <130 g/L for boys 15y +), inflammation-adjusted iron deficiency (ID, Ferritin <15 µg/L), iron deficiency anemia (IDA), and when available, vitamin A deficiency (VAD), zinc, vitamin B12 and folate deficiencies. Prevalence of stunting (Height for Age Z-score <-2), thinness (BMI-for-age Z, BMIZ<-2), and obesity (BMIZ < 2) were examined across countries and sex.

Results: Data from 12,996 adolescents found that prevalence of micronutrient deficiencies (MND) varied by sex and location. Anemia ranged from 0.4% in Guatemala to 23.8% in Malawi among boys, and 2.7% in Guatemala to 21.5% in Ghana among girls. Among boys, ID was 1.4% in Malawi and 14.1% in Mexico whereas IDA was generally low among boys, from 0.0% in Great Britain to 2.1% in Mexico. Among girls, ID was highest in Great Britain at 27.5% and lowest in Malawi at 12.3%, while IDA was 1.1 % in Ghana and highest in the US at 7.2%. Vitamin A data was available in 4 countries. Among boys, VAD ranged from 0.0 % in Malawi to 8.5% in Ecuador, while among girls, VAD ranged from 0.6% in Great Britain to 8.8% in Malawi. Zinc deficiency (3 countries) was 2.4% in Great Britain and highest in Malawi for both boys and girls at 58.6% and 56.3%, respectively, with the lowest for girls at 3.1% (Great Britain). Vitamin B12 deficiency (4 countries) among girls ranged from a low of 0.4% in Mexico to a high of 11.3 % in Malawi. Serum folate deficiency (3 countries) was low (<0.4%) among boys Mexico and Ecuador, but among girls, it was lowest at 1.0% in Ecuador and highest at 18.8% in Malawi. Like MND, the prevalence of stunting, thinness, and obesity varied widely across countries, sex, and the extremes of the distribution. For example, whereas thinness in girls was 0.0% in Great Britain, it was 14.0% in Nepal, conversely obesity was 10.2% in Great Britain and 0.7% in Nepal.

Conclusion: The wide variation in prevalence of multiple burdens of malnutrition among adolescents observed across geographic regions highlights the importance of continued surveillance to provide up-to-date data in this population group. Consistent monitoring of nutrition metrics is critical to the design of impactful interventions and to inform national policy.

Keywords: Adolescents, micronutrients, malnutrition, anemia, iron deficiency

Conflict of Interest Disclosure: None

Further Collaborators: None

SY(T9)14-2

Systems integration and partnerships to effectively deliver weekly iron and folic acid supplementation programs to adolescents in low-income and middle-income countries

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Adolescence is a time of rapid growth and development and increasing nutritional needs, especially in the case of iron for adolescent girls with a third estimated to be anaemic in low- and middle- income countries. Until recently adolescents have not been the focus of health and nutrition programs and they are among the least likely to access the health system for preventative services. Systems thinking goes beyond multisectoral delivery of programs and considers the multiple cross-cutting and interrelated determinants of malnutrition, identifying levers for positive change to increase impact, and fostering enhanced sustainability by working across systems and delivery platforms.

Methods: By applying a systems-based approach to improving adolescent nutrition, with a focus on expanding reach and impact of weekly iron folic acid supplementation (WIFAS) programs, we identify opportunities for increasing equitable reach of WIFAS in select countries in Asia and Africa. In addition to considering the health, education and social protection sectors that are engaged to deliver WIFAS, the current enabling environment within the country needs to be considered in order to inform programming decisions and outcomes such as program relevance, feasibility, design, and anticipated impact. This analysis includes the current context around policy and governance, infrastructure and markets, inputs and services, information and communication, financing, household resources, and the sociocultural environment. **Results:** Most WIFAS programs supported through the Right Start initiative in Africa and Asia initiated with school-based delivery, where the largest number of girls could be reached through a collaboration with the health and education sector. In some cases these programs were complemented by smaller scale resource-intensive facilities or community-based delivery with attempts to reach out-of-school girls. India, with the longest standing WIFAS programs operating at national and state level, is a country reaching millions of girls through a multisectoral WIFAS

program delivered through social protection, school platforms and collaboration and delivery, financing and reporting aligned with the health system. Vulnerable girls seem to be the hardest to reach through all channels, yet a systems approach offers more potential, especially adapting when vulnerability changes. This was especially relevant in COVID as all girls become out of school for varying lengths of time.

Conclusions: Adolescents have been among the most marginalized from the health system, making a systems-based approach strategic for addressing the complex issues and determinants of adolescent anaemia and weekly iron folic acid supplementation programs; yet strengthening the youth-responsiveness of health systems is also much needed as part of sustainable impact.

Keywords: Adolescent Nutrition, Systems Thinking, Weekly Iron Folic Acid Supplementation, Anemia, Delivery platforms for nutrition

SY(T9)15-1
Clinical Nutrition in COVID-19 – strategies for prevention, management and recovery

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Given the sustained global impact of the COVID-19 pandemic, many areas of health and lifestyle have been called into question and examined in this context. Malnutrition exists on a spectrum, with people at both extremes at greater risk of morbidity and mortality from infection. To this end, observational research into COVID-19 outcomes has shown that people with nutrition-related non-communicable conditions such as the metabolic syndrome, obesity and diabetes mellitus are at greater risk of morbidity and mortality from infection (1,2), while undernutrition in the clinical setting has also been predictive of poor outcomes (3). Accordingly, much has been written about the importance of nutrition in COVID-19 prevention and clinical management.

Specific attention has been given to the role of nutrition in immune health in the context of COVID-19, in particular the relationship between dietary micronutrients and infectious disease (4,5). In other respiratory infections, correction of micronutrient deficiencies has been effective in promoting improved immune responsiveness, granted the key observation of effect in these cases has been in those with deficient status (6). This emphasises the importance of robust systems for testing and treating nutritional insufficiencies and deficiencies, in cases of COVID-19 infection and more widely.

Through rapid changes in food environments and living conditions, a global nutrition transition is generating a new double burden of malnutrition (DBM) in which undernutrition and overweight co-exist within populations, and often within individuals. Both of these states have the potential to impair adequate functioning of the immune system (4). A bidirectional relationship exists between nutrition and infection, whereby poor nutritional status predisposes one to infection and the body's immune response against infection can be weakened by a poor nutritional status.

Mortality from COVID-19 has been highest among older people and those with comorbidities, who are also often most at risk of malnutrition in society. Malnutrition in these groups is often community acquired and associated with poor clinical outcomes in secondary care (7). To complicate this further, due to unprecedented service pressures during the COVID-19 pandemic, standard procedure and practice has been difficult to maintain and nutrition screening and assessment will have been impacted. Accordingly, people discharged from hospital are likely to be at high risk of malnutrition due to several factors including the effects of acute illness and additional barriers to nutrition support during hospital admission (8,9). This has likely resulted in a high prevalence of malnutrition in our communities, meaning increased vulnerability to future illness and infection.

The COVID-19 pandemic will be remembered for many reasons and will leave a lasting legacy on healthcare systems. However, one positive which could result from this impact is an increased acknowledgement of the important role of nutrition in this setting, with the recognition of nutritional status can be considered a modifiable risk factor in the prevention and treatment of COVID-19. This too provides a platform for the promotion of healthy diet and lifestyle choices to the population at large. Additional emphasis on public health messaging can be used as an opportunity to facilitate discussions around nutrition related behaviour change at a population level (10). Similarly, lessons learned during the pandemic can provide a catalyst for all healthcare professionals to embed nutritional care into routine practice.

Keywords: Clinical Nutrition, COVID-19, Immune Health, Malnutrition, Healthcare

Conflict of Interest Disclosure: N/a

SY(T9)15-2
Global Nutrition, COVID-19 recovery and Long COVID

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This session outlines the current evidence base and active research for nutrition in COVID-19 recovery and in the management of Long COVID. Malnutrition, in particular undernutrition and sarcopenia, is associated with prolonged recovery from COVID-19. Severe COVID-19, especially in patients requiring inpatient or intensive care, is a profoundly hypermetabolic condition that can lead to depletion of energy stores and lean muscle mass. Therefore, the recovery phase can be lengthy (months to years), disease severity can partly predict length of recovery, and patients with pre-existing malnutrition

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

are most at risk of infection-related weight loss and malnutrition. Chronic symptoms affecting taste, olfaction, swallow and the gastrointestinal tract can have obvious implications for nutritional intake. Currently, the core principles of optimal nutrition in recovery from COVID-19 are akin to recovery from other infectious diseases, namely meeting adequate protein, macronutrient and micronutrient requirements, taking into account deficits in these dependent on age, baseline nutrition status, biometrics, disease course and complications.

Long COVID (also termed post COVID-19 condition) is a heterogenous syndrome characterized by persistent symptoms (commonly fatigue plus cardiorespiratory, neurological, gastrointestinal, or other symptoms) occurring beyond 12 weeks following initial infection. It can limit physical and cognitive function, independence and quality of life. In most countries, healthcare services for patients with Long COVID are variable, with clinicians of many different specialties running clinics that vary by region and healthcare system. There are several clinical research trials exploring the natural history and management of Long COVID; most of these assume value from a multi-disciplinary approach to Long COVID management, yet data on nutritional factors appear to be included in very few active trials. Our group advocates for nutrition assessment and individualised management to be actively included in Long COVID clinical services and research. We are collaborating with researchers to better understand the role of nutrition in Long COVID.

Keywords: Nutrition, COVID-19, Rehabilitation, Long COVID, Recovery.

SY(T9)15-3
Tailoring science communications including nutrition and health advice to different regions, at different times during the COVID-19 pandemic to date

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The COVID-19 pandemic presented unprecented challenges in almost all areas of public, private and professional life. The ever-evolving nature of the COVID-19 pandemic was unlike almost any phenomena encountered by those in the field of science, research or clinical practice. While this presented some very predictable hurdles, it also created difficulties for those communicating the emerging evidence around the virus, treatments and vaccines. The NNEdPro Global Centre attempted to contribute to the growing need for accurate, reliable and region specific resources through the establishment of our COVID-19 Taskforce and its own dedicated microsite[1]. With its far-reaching regional networks, NNEdPro was in a prime position to host a repository of generic and region specific public health resources to highlight upto-date policy and practice across the globe. The primary aims of this Taskforce was to improve health during the COVID-19 pandemic, by focusing on nutrition research, clinical practice and public health.

The first step was to establish our Taskforce, with membership made up of clinicians, public health nutritionists and social scientists to name but a few. Meeting online to discuss the developments in the pandemic and the response from the scientific world, the Taskforce set about addressing some of the early nutrition issues plagued by inaccuracies and embelishment. One of the early nutrition claims during the pandemic was regarding foods that could 'boost' your immune system. In many cases, those sharing these ideas meant well, however the concern arose in the Taskforce that this may cause people to disregard other advice such as to stay at home, wash their hands and adhere to social distancing. As a result, a pair of articles were written in a local newspaper attempting to dispell the myths that had arisen in early spring 2020[2,3]. In addition, a simple 10-point plan with associated pictures was created to show how people could support a healthy immune system through diet[4]. Drawing on our global networks, this guide was later translated into a dozen international languages[4] and has since been viewed more than 13,000 times.

NNEdPro's flagship journal, BMJ Nutrition Prevention and Health, soon established a special collection on Nutrition Interactions with COVID-19. Among the first articles published were a report on the potential role of vitamin D in COVID-19[5], a comprehensive review of the role of nutrients in immunity[6] and an appraisal of the evidence for dietary micronutrients in COVID-19 specifically[7]. Importantly, all articles were open access and were therefore open to all.

The Taskforce felt that one of the most important factors in our work, was promoting and sharing reliable information. This required constant surveillance by team members around the emerging literature and public health interventions, communication with leaders in our global networks and collation of information in one online repository. Perhaps as importantly, we continued to produce educational material in real time in the shape of webinars, podcasts and our International Summit. Our aim throughout was to help combat some of the misinformation that arose over the course of the pandemic and we can reflect now on some of the lessons learned along the way in this symposium.

Keywords: nutrition, COVID-19, sci-comms, pandemic, online.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

SY(T9)15-4
Nutritional preparedness for future waves of the SARS-CoV-2 and similar respiratory viruses

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Since the initial infections in 2019, the SARS-CoV-2 pandemic has proceeded in several waves. There have been strong indications that nutritional circumstances, particularly vitamin D deficiency, importantly contribute to the build-up of epidemic waves, during the dark season in high-latitude regions (Kohlmeier 2020, Ilie et al., 2020, Rhodes et al., 2020). Large segments of the populations countries at high latitude are known to be vitamin D deficient in winter and spring (Hanssen et al., 2018, Lanham-New et al., 2020). We are reporting here our previous experience with planning a community-based intervention to reduce virus transmission while mitigating disease outcome. This randomized intervention design is to be implemented in areas with high infection rates, targeting adults, who just received a negative antigen test and are thus not yet infected or are at a very early stage of infection. When they agree to participate, they will be randomized to moderately high oral vitamin D or placebo and asked to immediately start with their assigned regimen. Use of the supplements is to continue until the local infection rates return again to low risk levels. The primary outcomes of interest are self-reported morbidity as well as hospitalization and death rates. The main barrier to obtaining the requisite support for a sufficiently powered intervention trial was the low confidence in a substantive role of seasonal vitamin D deficiency in respiratory tract virus infections. Several trials with vitamin D at the time had reported failure to achieve the intended disease mitigation. However, all of them started supplementation many days or even weeks after the viral infection was already established. At least three different Mendelian randomization studies all reached the conclusion that vitamin D is unlikely to mitigate infection, but there are questions whether the genetic instruments are adequate proxies for vitamin D status during winter (Kohlmeier, Baah, 2021). A few other studies estimating vitamin D intake before infection and following infection risk and disease outcomes observed lower transmission and milder outcomes. The generally favorable results of these studies only become available after efforts had failed to get an intervention trial off the ground. The current state is that we still do not know with enough confidence that avoiding vitamin D deficiency will reduce SARS-CoV-2 transmission. Trials of the kind described above are just as urgently needed as before, not least in light of potentially different effectiveness with newer virus variants.

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Lanham-New SA, Webb AR, Cashman KD, *et al*. Vitamin D and SARS-CoV-2 virus/COVID-19 disease. *BMJ Nutrition, Prevention & Health* 2020;0.

Keywords: SARS-CoV-2, Vitamin D, Trial, Nutrition, Transmission

Conflict of Interest Disclosure: No conflict.

SY(T9)15-5
Reflections from 2.5 years of NNEdPro Nutrition and COVID-19 taskforce activity

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Background and objectives: The NNEdPro Global Centre for Nutrition and Health established its Nutrition and COVID-19 taskforce in March 2020 to aid the pivoting of operations and provide a focal point in the public health, healthcare and health research landscape for nutritional issues relating to COVID-19.

Methods: Critical and constructive reflections at 24 months (March 2020-March 2022) using an implementation science framework by key taskforce representatives.

Results: Successes to date include: (1) transitioned to online operations whilst maintaining research and educational activities; (2) contributed significantly to the research evidence base on nutrition and COVID-19 risk prevention, clinical management, and food security; (3) established an up-to-date and dynamic library of resources for professionals and the public; (4) multisector collaborations, including with key academic and industry partners, frontline healthcare providers, and medical publishing (joint special collection with BMJ Nutrition, Prevention and Health with over 25 papers); (5) provided a platform for early-career researchers; (6) disseminated region-specific information through established networks and social media platforms; (7) provided scientific content for novel nutrition science communications forum, IKANN-25; (8) advocated at national and international levels for inclusion of nutrition in COVID-19 policy. Challenges faced include: (1) navigating transitions through pandemic phases and shifting clinical and research priorities, with variable timelines across global regions; (2) the widespread lack of sustained grant funding available for nutrition research in COVID-19, especially for interventional trials in high risk populations; (3) limited acknowledgement in official policy that certain forms of malnutrition are modifiable factors in COVID-19 prevention and

mitigation, compared to other public health measures, e.g. face masks and vaccinations; (4) remaining true to the evidence-base and maintaining scientific rigour when discussing nutrition during the pandemic, which is particularly challenging in social media discourse. Future priorities include nutrition in COVID-19 recovery and long COVID, the pandemic's impact on nutrition and food security, and nutrition in future pandemic planning and resilience.

Conclusions: This taskforce has championed the role of nutritional factors in COVID-19 research, education, clinical practice, and policy through wide-ranging and collaborative activities with the emergence of a forward looking programme led by implementation thinking.

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[Further Collaborators] We acknowledge all past and current members of the NNEdPro COVID-19 and Nutrition taskforce.

Keywords: Public health, COVID-19, SARS-CoV-2, clinical nutrition, research

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SY(T9)16-1
Impacts of the COVID-19 pandemic on diets, nutrition practices and nutrition services in UNICEF's Eastern and Southern Africa region: Evidence from remote surveys in Botswana, Eswatini, Lesotho, Kenya, Malawi, Uganda

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UNICEF's Eastern and Southern Africa Regional Office (ESARO) undertook research to understand the impacts of the COVID-19 pandemic on diets, nutrition practices and nutrition services in the region. Remote data collection took place remotely in six countries (Botswana, Eswatini, Lesotho, Kenya, Malawi, Uganda) between May and August 2021 using telephone and internet surveys. Overall, 57,589 respondents took part in the survey.

Results show that 59% of caregivers reported reduced consumption of one or more healthy food groups for children aged 6-23 months (average 3 out of 11 healthy food groups) due to COVID-19, with the biggest reduction reported in animal source foods and unhealthy foods. 20% of caregivers of children under two years reported that their infant was breastfed less often due to COVID-19. 82% of caregivers of children aged 2-18 years and self-reporting adolescents aged 15-18 years reported reduced consumption of one or more healthy food groups due to COVID-19 (average 5.7 out of 13 food groups) and 73% of caregivers of children who responded via internet surveys reported that their child consumed reduced variety of foods since COVID-19. Animal source foods and unhealthy drinks and snacks were the food groups most frequently reported to be consumed less among children aged 2-18 years. 84% of pregnant and lactating women (PLW) reported reduced consumption of one or more healthy food groups due to COVID-19 (5.5 out of 13 food groups), with the biggest reductions reported in animal source foods and unhealthy drinks and snacks.

Severe household food insecurity according to the Food Insecurity Experience Scale (FIES) was reported by 39% of caregivers of children under two years, 33% of caregivers of children aged 2- 18 years, and 34% of PLW. Severe or moderate household food insecurity was reported by 76% of caregivers of children under two years, 74% of caregivers of children aged 2-18 years, and 72% of PLW. PLW reported that, while food continued to be available on markets, food access fell due to reduced purchasing power, either because of lack of money (61% of respondents) or higher food prices (33% of respondents). COVID-19 disrupted nutrition services in ESA with the largest negative impact reported by both service users and service providers on maternal health and nutrition services, Iron and Folic Acid supplementation for adolescent girls, and nutrition counselling.

Results indicate that the COVID-19 pandemic had a negative impact on infant and young child feeding practices in terms of reduced frequency of breastfeeding and a negative impact on child, adolescent and mothers' diets in terms of reduced variety of foods consumed, and reduced consumption of animal source foods rich in protein and micronutrients. Results also suggest some positive impacts on diets in terms of reduced consumption of unhealthy drinks and snacks and increased consumption of micronutrient-rich vegetables. Resources are urgently needed to re-expand and prioritize efforts to prevent stunting and micronutrient deficiencies in ESA. Use of remote survey methods enabled the collection of nutrition data during COVID-19 related movement restrictions, but remote methods have important limitations and more research and guidance is needed on their use.

Keyword: COVID-19, diets, infant and young child feeding, food insecurity

SY(T9)16-2
How COVID-19 affected maternal and infant nutrition practices, health service delivery and food systems in Kenya: Key Findings and Program Implications

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Background: This implementation science study, is one of the first, to comprehensively understand the effects of COVID-19 on maternal health service delivery and the concurrent impacts on breastfeeding practices in Nairobi and Uasin Gishu Counties, Kenya. **Methods**: The study triangulated in-depth interviews (IDIs) with 31 lactating women (including COVID-19 positive), 10 health workers, 10 community health volunteers, 15 IDIs and 4 focus group discussions with government stakeholders and implementing partners from urban (Nairobi County) and rural areas (Uasin Gishu County) of Kenya. Secondary analyses of trends in Kenyan Health Information System (KHIS) facility and breastfeeding indicators was also conducted. **Results**: Attendance of maternal and child health services declined and was attributed to fear of COVID-19 infection, transportation issues and COVID-19 imposed restrictions. Facility and community health providers described confusion surrounding provision of guidance around breastfeeding for women who were at-risk or COVID-19 positive. Fear of COVID-19 infection early in the pandemic disrupted early and exclusive breastfeeding practices, which was subsequently addressed by the health workforce, as women relayed exclusively breastfeeding due to stay-at-home orders. Importantly, the COVID-19 pandemic negatively affected the diets of both pregnant and lactating women and provision of psychosocial support during the pandemic was limited. Reductions in overall food choice and consumption for women and their households were driven by high food insecurity, pandemic-fueled unemployment, and higher prices of most food items. In addition, access to markets and availability of perishable foods was compromised during the pandemic. **Conclusion**: Efforts to "build back better" for COVID-19 should include addressing gaps pertaining to maternal, infant and young child nutrition counseling and health education at facility and community level to prevent disruptions in maternal and infant health services and related nutrition practices due to pandemic-related misperceptions and taboos. This should include strengthening provision of practical, culturally responsive nutrition and psychosocial support for women and their families.

Keywords: breastfeeding, COVID-19, maternal nutrition, maternal and child health services, food systems

Conflict of Interest Disclosure: None

SY(T9)16-3
An exploration of the effect of COVID-19 on adolescent nutrition in Kenya: Key Findings and Program Implications

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Background: This implementation science study sought to gain a better understanding of the effects of COVID-19 on adolescent food choice, dietary intake, and related behaviors in Nairobi and Uasin Gishu Counties, Kenya. **Methods**: The study triangulated eight focus group discussions (FGDs) conducted with adolescents 10-19 years of age, in-depth interviews with ten health facility providers, and a combination of FGDs and key informant interviews with government stakeholders and implementing partners (n=13) from urban (Nairobi County) and rural areas (Uasin Gishu County) of Kenya. **Results**: During the COVID-19 pandemic, adolescents tended to avoid commonly consumed junk foods, in favor of immune-boosting "protective" foods. Widespread unemployment rendered some food items unaffordable for families of adolescents. Adolescents relayed experiences of reductions in dietary intake and used various strategies to support families financially, in response to rising food insecurity. School closures mandated during the pandemic likely contributed to declines in overall physical activity and a greater tendency among adolescents to engage in risky behaviors, which were disruptive to adolescent health.

Conclusion: To improve the diets of adolescents and build back better from COVID-19, country programs should build on the healthy mindset brought on by the pandemic while providing additional targeted nutrition-sensitive measures (i.e. social protection, agriculture initiatives) to cushion adolescents and their families from rising food insecurity, as an effect of COVID-19.

Keywords: adolescent nutrition, COVID-19, physical activity, food insecurity, dietary diversity

Conflict of Interest Disclosure: None

SY(T9)16-4

How have poor urban populations' food security and food purchasing habits been impacted by COVID-19? Insights from three city slums in Asia

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The COVID-19 pandemic has threatened the nutrition status of people around the world, particularly the youngest, the poorest and the most vulnerable. The pandemic, and the extraordinary measures needed to contain it, have constrained access to nutritious and affordable foods, disrupted health and nutrition services and overburdened social protection systems in many contexts. In Asia, the pandemic's impact on food chains and the economic impact on households are now well documented. During the pandemic, many vulnerable households – including those in poor, urban areas – remain at risk of food insecurity, with potential increases in malnutrition especially for young children and women. A cross-sectional survey was implemented in 2020-2021 to assess the impact of COVID-19 on food security, diet quality and access to essential services among poor urban communities in three South East Asian cities (Jakarta in Indonesia, Quezon city in the Philippines and Yangon in Myanmar). Data were collected on household food insecurity (FAO Food Insecurity Experience Scale) and nutrition indicators using Computer Assisted Telephone Interviewing (sample size of 730 households in Jakarta, 2700 in Quezon city and 3077 in Yangon) and compared with pre-COVID-19 baseline data when available. A COVID-19 impact index composite of category of shock severity and livelihood based coping strategy was developed and used to assess the level of exposure to COVID-19. Measurement of qualitative impact of COVID-19 was based on respondents' perceptions towards changes in their food provisioning, consumption and feeding patterns during the pandemic. COVID-19 has exacerbated poverty in vulnerable populations. Households in extreme poverty were most severely impacted by COVID-19 compared to all other income groups. Concerns about food in the last month was seen in many households in Jakarta (66%), Quezon City (87%) and Yangon (74%) and it was highest among households that were most severely impacted by COVID-19 in 2 cities (using the COVID-19 impact index). There was an interplay between food affordability and physical access. Households dramatically altered the way they purchased food, to cope with financial in-access and physical access challenges, either by reducing purchases of nutrient-dense foods or substituting. Given that the COVID-19 crisis pushed vulnerable urban populations further into poverty, it is crucial that authorities and stakeholders responsible for governance and oversight of food systems in urban areas coordinate, to ensure innovative and sustainable monitoring system of the nutrition and livelihoods situation among the urban poor. It is also important to design social protection interventions to support households in coping with shocks and disruptions to the urban food system. Specific actions for food security, social protection, nutrition and monitoring are recommended.

Keywords: Diet, Covid-19, Food insecurity, Asia, Slums
Conflict of Interest Disclosure: None

SY(T9)16-5

Urban food systems in Asia: COVID-19, food security and resilience. An analysis and characterization of 8 urban food systems in selected cities in Asia

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Background and objectives: The COVID-19 crisis has significantly disrupted food systems, particularly, those that support urban populations. However, insufficient evidence existed on the impact on availability, access, and use of foods for vulnerable urban populations. The gaps in evidence of urban food system weaknesses during the COVID-19 crisis and the likely consequences on food security and nutrition in poor urban population indicated a need to better understand urban food system dynamics and identify areas of interventions for the World Food Programme and other partners.

Methods: This research study conducted in early 2021, assessed the level of resilience of urban food systems in the face of the COVID-19 crisis in eight selected cities in Asia. A range of methods and data sources were used to characterize urban food systems and explored external drivers, food supply chains, food environments, individual factors, consumer behaviour and diet outcomes. In addition to analysis of secondary data and geospatial data, primary data were collected from private sector, local government actors, UN agencies, NGOs and community-based organizations using both quantitative and qualitative data collection methods. collection methods.

Results: COVID-19 has increased levels of vulnerability and food insecurity in cities through three main mechanisms, which varied geographically between cities and temporally throughout the pandemic. These include 1) disruptions to food supply chains; 2) Increased food prices; and 3) Loss of income. The combination of increased food prices and loss of income affected food affordability for the urban poor. Food prices increased during the pandemic in all eight cities, with considerable variations between cities and between food groups. The analysis suggests that food systems in the eight cities did not show high levels of resilience to respond effectively to the pandemic.

Conclusions: There is a need for governments and development actors to consider innovative response to COVID-19 and to strengthen the resilience of urban food systems against inevitable future shocks. Positive opportunities for transformation of urban food systems exist. Innovative

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

transformations represent an area that could be strengthened on the supply side to increase the resilience of the economy and the livelihoods of those working in the food system by protecting income and the access of vulnerable individuals to the food system.

Keywords: Food system, COVID-19, urban, resilience, Asia
Conflict of Interest Disclosure: No conflict of interest

SY(T9)17-1
Total dietary fat intake, fat quality and health outcomes: scoping reviews of systematic reviews of prospective studies and current guidelines

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Introduction: We conducted a scoping review of systematic reviews (SRs) on dietary fat intake and health outcomes in human adults, and a scoping review of dietary guidelines with the intent of developing a position paper by the "IUNS Task force on Dietary Fat Quality" tasked to summarize the available evidence and provide the basis for dietary recommendations. **Methods**: We systematically searched several databases for relevant SRs of randomized controlled trials (RCTs) and/or prospective cohort studies published between 2015-2019 assessing the association between dietary fat and health outcomes. We systematically searched several databases and websites for relevant guidelines published between 2015-2019. **Results**: Fifty-nine SRs and twenty guidelines were included. The findings from SRs of prospective cohort studies, which frequently compare the highest vs. lowest intake categories, found mainly no association of total fat, monounsaturated fat (MUFA), polyunsaturated fat (PUFA), and saturated fat (SFA) with risk of chronic diseases. SRs of RCTs applying substitution analyses indicate that SFA replacement with PUFA and/or MUFA improves blood lipids and glycemic control, with the effect of PUFA being more pronounced. A higher intake of total trans-fat, but not ruminant trans-fat, was probably associated with an increased risk of mortality and cardiovascular disease based on existing SRs. Findings form current guidelines indicated quantitative range intake recommendations for daily total fat intake included boundaries from 20-35% of total energy intake (TEI), for monounsaturated-fat (MUFA) 10-25%, for polyunsaturated-fat (PUFA) 6-11%, for saturated-fat (SFA) =<11-=<7%, for industrial trans-fat (TFA) =&<2-0%, and <300-200 mg/d for dietary cholesterol. The methodological approaches to grade the strength of recommendations were heterogeneous, and varied highly between the included guidelines. Only the WHO draft guideline applied the GRADE approach and graded the following recommendation as "strong": to reduce SFA to below 10%, and TFA to below 1% and replace both with PUFA if SFA intake is greater than 10% of TEI. **Conclusion**: Overall, the available published evidence deems it reasonable to recommend replacement of SFA with MUFA and PUFA and avoidance of consumption of industrial trans-fat.

Keywords: dietary fat
Conflict of Interest Disclosure: No conflict of interest to declare

SY(T9)17-2
Changes in dietary fat intake over time

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Current situations and trends in dietary fat intake from national representative survey were investigated in Japan (National Health and Nutrition Survey (NHNS), since 1946), Korea (Korean National Health and Nutrition Examination Survey (KHANES), since 1998), US (National Health and Nutrition Examination Survey (NHANES), since 1999 annually), and UK (National Diet and Nutrition Survey (NDNS), since 2008).

Current situations of dietary fat intake (% total energy (TE)) were estimated to be 23% in Korea 2018, 29% in Japan 2019, 33% in US 2016 and 34% in UK 2016-18. In Japan, it was only 6% in 1948 and sharply increased to 10% in 1958 and over 20% in 1973. Thereafter it was gradually increased and over 25% in 1988 and 29% in 2019. The increased trend was also observed in Korean men, 19% in 2008 to 23% in 2018, and women, 18% to 22%. In US, it was gradually increased from 32% in 1999 to 36% in 2018 and almost stable, 33% in 2008-9 and 34% in 2016-8 in UK.

Regarding quality of dietary fat, saturated fatty acid (SFA) intake(%TE) was less than 10%; 8.7% in Japan and 7.0% in Korea, however it showed the increasing trend. In US and UK, the trends were almost stable, but the values exceed 10%, approximately 12%. Monounsaturated fatty acid (MUFA) intake (%TE) was currently 11% in Japan, 7% in Korea, 12% in US and 13% in UK. The trends were parallel with SFA. In contrast, US adults experienced a significant increase in %TE from polyunsaturated fatty acid (PUFA). Current PUFA intake was 6.1% in Japan, 5.5% in Korea, 8.4% in US and 6% in UK. Global consumption and changes in fat intake from Global Dietary Database (https://www.globaldietarydatabase.org/) are also investigated. This database contains diet exposure data drawn from national health surveys and nutrition databases, compiled by researchers of the Global Dietary Database Consortium, part of the Global Burden of Disease Nutrition and Chronic Disease Expert Group (NutriCoDE). Daily intake (g/day) of meats, milk and seafood, major source of dietary fat, are 51, 150 and 75 in Japan, 55, 85 and 59 in Korea, 76, 199 and 18 in US and 61, 260 and 30 in UK. These data support higher saturated fatty acid intake and lower marine n-3 PUFA intake in US and UK. GDD also provides dietary trans fatty acid (TFA) intake and %TE was estimated to be 0.9-1.0% in Japan and Korea and 1.4-2.7% in UK and US.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Global trends of dietary fat were also investigated by systematic analysis including 266 country-specific nutrition survey as a part of NutriCoDE. In general, while SFA and TFA were stable, the intakes of n-3 and n-6 PUFA were gradually increased between 1990 and 2010.

Keywords: Dietary fat, Current situation, Trend, saturated fatty acid, polyunsaturated fatty acid

SY(T9)17-3
Recommendations of the IUNS Task Force on Dietary Fat Quality

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The IUNS created a Task Force to prepare evidence based position paper and recommendations on the Advisable Quality of Dietary Fat. This report is supposed to be shared with the national nutrition societies and the scientific community, as well as practitioners in the health and nutrition fields, public health and regulatory bodies, and food producers. Key messages shall also to be shared with the public. A group of twelve experts in the field from around the field agreed to contribute to the work, comprising both eminent experts and early career scientists. While we had originally intended to hold one or more face to face meetings of the expert group, due to the Covid-19 pandemic we reverted to online discussions. The task was discussed and the key questions to be addressed were agreed upon. Two scoping reviews of systematic reviews relating to recommendations in the adult population were performed to serve as the basis of the work (1, 2). Based on these recommendations on dietary fat intake and dietary fat quality for the adult population were agreed upon in consensus. The group decided to expand the work and also perform systematic reviews on the evidence for pregnant and lactation women, and for infants and children, which are ongoing at the time of writing this abstract. The outcomes and conclusions will be presented.

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Keywords: Reference nutrient intakes, food based dietary guidelines, dietary fat quality, cardiovascular disease, pregnancy.

SY(T9)18-1
Evidence-based guideline on protein intake and disease prevention

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The German Nutrition Society is currently developing an evidence-based guideline on protein intake which focuses on the role of dietary protein intake for the primary prevention and risk modification of various non-communicable diseases. The aim of this guideline is to investigate whether dietary protein intake with regard to quantitative (higher vs. lower dietary protein intake) and qualitative considerations (total, plant-based or animal-based protein intake) affect the development of selected health-related outcomes in the general adult population. The following outcomes are investigated: blood pressure, body weight and body weight-related outcomes, bone health, cancer, cardiovascular diseases, kidney health, muscle health and type 2 diabetes mellitus. To assess the overall certainty of evidence for each health-related outcome, umbrella reviews of systematic reviews with or without meta-analyses of prospective studies are conducted. Systematic literature searches are performed in the three databases PubMed, Embase and Cochrane Database of Systematic Reviews. The methodological quality and outcome-specific certainty of evidence is evaluated using a modified version of “A Measurement Tool to Assess Systematic Reviews 2” (AMSTAR 2) and the NutriGrade scoring system, respectively. The overall certainty of evidence is assessed for each relevant exposure-outcome link based on the consistency of results, the methodological quality, the outcome-specific certainty of evidence and the biological plausibility. Finally, results from all health-related outcomes will be brought together and overall recommendations regarding dietary protein intake will be derived based on an Evidence to Decision framework. This will consider the overall certainty of evidence derived from the outcome-specific umbrella reviews, but also other aspects such as ecological sustainability, dietary intake levels of protein and dietary preferences.

Keywords: Evidence-based guideline, Protein intake, Prevention, Nutrition-related diseases

Further Collaborators: Jürgen M. Bauer, Heike A. Bischoff-Ferrari, Heiner Boeing, Sarah Egert, Sabine Ellinger, Tilman Kühn, Sandrine Louis, Stefan Lorkowski, Katharina Nimptsch, Thomas Remer, Matthias B. Schulze, Roswitha Siener, Gabriele I. Stangl, Dorothee Volkert, Armin Zittermann

SY(T9)18-2
Update on extra-skeletal health effects of vitamin D - implications for recommendations

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There is accumulating evidence that vitamin D may beneficially affect several extra-skeletal diseases, including respiratory tract, autoimmune, neurodegenerative, and mental diseases. We identified systematic reviews (SRs) of cohort studies and randomized controlled trials (RCTs) as well as single Mendelian randomization studies and summarized the results in an umbrella review. Observational data on primary prevention suggest an inverse association between vitamin D status and the risk for acute respiratory tract infections (ARI) and depression, whereas data for asthma, multiple sclerosis (MS), and type-1 diabetes mellitus (T1DM) are still scarce. SRs of RCTs support the observational findings in the case of ARI. Further, SRs of RCTs indicate beneficial therapeutic vitamin D effects in patients with asthma and COPD. In addition, we also reviewed the literature on the specific association between vitamin D status and COVID-19 disease risk and severity of the disease. The implications for recommendations to the general public or for specific high-risk groups are being discussed.

Keywords: vitamin D status, diseases, review, COVID-19

Further Collaborators: Working groups on vitamin D at the German Nutrition Society

SY(T9)18-3
Food-based dietary guidelines in Germany

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Background and objectives

The current food-based dietary guidelines (FBDG) in Germany already prove to be environment-friendly and health-promoting. In their derivation, predominantly the coverage of nutrient needs was considered among diet-health relations and dietary habits. In view of the pressing challenge of the environmental burden of diets, mathematical optimisation techniques are suitable tools to simultaneously account for the interrelated and conflicting properties of foods. For the new generation of FBDG for Germany, the objective is to develop an evidence-based, transparent methodology to identify dietary changes accounting for the sustainability dimensions health, environment, and social issues. The methodology shall also enable the integration of further dimensions and associated indicators.

Methods The derivation process and selection of dimensions was guided by the definitions and frameworks for FBDG derivation of official international institutions and by common optimisation practices. Two workshops, organised by the Federation of European Nutrition Societies, gave guidance as well. The indicators of the dimensions were operationalised according to the goals of the FBDG and also mathematical conditions. As the underlying food categorisation system, FoodEx2 by the European Food Safety Authority was selected.

Results Three parameters define the optimisation algorithm: 1) The decision variables, which are observed food intakes; 2) acceptability constraints, and 3) the linear objective function. The latter consists of three components that are weighted against each other and minimizes environmental impact (dimension environment; included indicators: greenhouse-gas emissions and land use), diet-related health burden (dimension health; included indicator: disability adjusted life years), and relative deviation from the observed dietary intake (dimension social issues; included indicator: dietary habits).

Conclusions

Our innovative approach enables the integration of multidimensional requirements in FBDGs and is flexible regarding the importance given to each indicator. It will support the derivation of healthy and sustainable FBDG for Germany.

Keywords: Food-Based Dietary Guidelines, FBDGs, Diet modelling, Sustainability, Diet optimisation

Further Collaborators: Ulrike Arens-Azevedo, Kurt Gedrich, Maike Gutmann, Hans Hauner, Helmut Heseker, Anja Kroke, Jakob Linseisen, Stefan Lorkowski, Ute Nöthlings, Britta Renner, Lukas Schwingshackl

SY(T9)18-4
How to shape and assess dietary behavior using mobile devices

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Technological development in the field of mobile technologies is proceeding at a rapid pace increasingly immersing everyday life. The regular use of smartphones and other mobile technologies also opens up new avenues for dietary surveys and behavioral change. The technical features of smartphones, such as GPS and cameras, enable users to document and track their eating habits in daily life. In addition, it is also possible to record complex data about eating behavior at the moment of experience in specific everyday situations. New technologies thus offer not only **more** data, but also qualitatively **different** data. For example, they show us time

signatures, when and for how long food is eaten, and also the circumstances, e.g., where and with whom food is eaten.

Furthermore, mobile technologies can also be used to tailor behavior change interventions more specifically to individual user needs and specific eating situations. These potentials of mobile technologies for dietary monitoring and intervention are illustrated by recent results from a systematic review and meta-analysis comprising 6348 participants and 373 outcomes with sample sizes ranging from 10 to 833, including 27 randomized controlled trials (RCTs). Here a beneficial effect of app-based mobile interventions was identified for improving nutrition behaviors (g= 0.19; CI 0.06-0.32, P = .004) and nutrition-related health outcomes (g = 0.23; CI 0.11-0.35, P = .001). Research conducted within the BMBF project SMARTACT show first promising results in terms of improving dietary behavior and various health parameters. Taken together, the potentials of mobile technologies for changing eating behavior are discussed with respect to higher-level perspectives such as Food as Health and Food as Well-being.

Conflict of Interest Disclosure: none

Keywords: Nutrition, mHealth, mobile-apps, intervention, prevention

SY(T9)19-2
Measuring sustainable diets: nutrition and ecosystem metrics

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Sustainable diets are described as diets with a low environmental impact that are nutritionally adequate, safe and healthy, as well as socially and culturally acceptable, affordable and accessible. This FAO definition is a widely accepted and used, but the multidimensional and complex nature of sustainable diets presents a significant challenge in measuring them. A clearly defined metrics is necessary to assess progress towards diet-related goals and targets (including many of the Sustainable Development Goals), to formulate dietary guidelines, inform policy development and to help consumers make food choices. To date, there is no commonly agreed metrics for measuring sustainable diets. The objective of this presentation is to review of the development and use of metrics for measuring sustainable diets. Sustainable diets can be divided into three general components, health and nutrition, environment, and social and economics. Within each component there are multiple attributes and potential measurements, for example, nutrient requirements, diet diversity, nutrient density and consumed of specific foods can be used to measure aspects of nutrition and dietary quality. The metric chosen is often based on the availability of data. Reviews have shown that the majority of published papers comparing dietary patterns used greenhouse gas emissions as a surrogate for environmental impacts because of the existence and accessibility of data. However, greenhouse gas emissions data are often a global average figure that can be too general as it masks the variation in production methods that is particularly important when comparing low- and middle-income countries with high-income countries. An advantage of using metrics is that it can highlight potential unintended consequences that would not be foreseen if a single attribute was used. For example, nuts are included in many food-based dietary guideline and while they tend to be associated with relatively low greenhouse gas emissions, they are water intense and commercially grown in water scare areas of the world. Similarly, sustainable diets are often associated with plant-based diets, which are assumed to be healthy and have a low environmental impact, but this is not necessarily the case, especially today with increasing availability of highly processed plant-based foods in many countries.

Conflict of Interest Disclosure: none

Further Collaborators: none

Keywords: sustainable diets, health, environment, metrics, nutrition

SY(T9)19-3
The Ecological Nutrition Framework for Informing Nutrition Activities (ENFINA): Guiding fit-for-purpose decision-making to promote sustainable diets

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The rapid transition in food systems around the world and the emergence of novel dietary patterns dominated by ultra-processed foods, increasing animal-/plant-sourced food ratios and rising food waste has no ecological or evolutionary precedent. Sustainable diets are being threatened. Nutrition policymakers have an unparalleled amount of evidence available to inform the development of dietary guidelines and policy actions to promote sustainable diets. However, decision-making processes are fraught with scientific and political challenges when developing evidence-informed nutrition activities. This presentation reports on the development and strategic application of 'ENFINA', the Ecological Nutrition Framework for Informing Nutrition Activities, as a novel tool to guide decision-making for nutrition activities to promote sustainable diets.

Nutrition science is complex and has a history of developing well-intended but ineffective nutrition activities, often with adverse unintended consequences. The field of Ecological Nutrition provides a theoretically grounded scientific basis for guiding 'fit-for-purpose' nutrition activities. In this study Ecological Nutrition was defined as, 'an interdisciplinary body of knowledge, methods, and tools which encompass nutrition-mediated interactions between human physiology and food environments based in ecological and evolutionary theory'.

How can fit-for-purpose decision-making be operationalised in practice? Core concepts from ecological and evolution theories were synthesised to underpin the design of ENFINA. The

framework proposes reforms to the conventional nutrition evidence synthesis and translation methods from their current mostly 'one-size-fits-all' and nutrient-centric (reductionist) orientations to an orientation that is fit-for-purpose for nutrition activities intending to promote sustainable diets.

The framework is applied to integrate a sustainability dimension into food based dietary guidelines as well as nutrition actions such as front-of-pack labelling. The application of the framework's fit-for-purpose orientation to how evidence is synthesised and translated for nutrition decision-making increases the likelihood that the resulting nutrition activities will be effective and less prone to adverse unintended consequences in promoting sustainable diets.

Keywords: Ecological Nutrition, Sustainable diets, Dietary guidelines, Fit-for-purpose, ENFINA

Conflict of Interest Disclosure: No conflicts on interest to declare.

Further Collaborators: Acknowledgement: Lawrence M, Baker P, Worsley A, McNaughton S. Reforming evidence synthesis and translation for food and nutrition policy. Australian Research Council Discovery Project; DP190101323

I am a member of the Food Standards Australia New Zealand (FSANZ) Board, the views I present are not necessarily those of the FSANZ Board. I alone am responsible for the views expressed in this presentation.

SY(T9)19-4
Highlights from the High Level Panel of Experts of the Committee on World Food Security

Barbara Burlingame[1]

1. Massey University (New Zealand)

Background and objectives: The High Level Panel of Experts on Food Security and Nutrition (HLPE) is the United Nations body for assessing the science related to world food security and nutrition. It is the science-policy interface of the Committee on World Food Security (CFS) and provides independent, comprehensive and evidence-based analysis and advice through a scientific, transparent and inclusive process, grounded the principle of food/nutrition as a human right.

Methods: Policy recommendations concerning sustainable diets, extracted from the 18 reports of the HLPE, are presented, with emphasis on nutrition and food systems, agroecology, climate, the role of livestock, food losses and waste, data and analysis tools, critical and emerging issues in food security and nutrition, and the global narrative.

Results: Focussing on human nutrition and environmental/ecosystem sustainability, a range of specific policy recommendations are presented, covering global to local levels, to achieve the vast number of goals and targets related to food security and nutrition. Two new dimensions to the formal definition of food security were proposed to be widely applied, consistent with the concept and definition of sustainable diets: 'sustainability' and 'agency'. Sustainability is the fundamental, indispensable element that requires immediate actions in the present to safeguard the future of food security and nutrition. Agency is the element that enables/facilitates individuals and communities to use their own power to effect change, even when top-down political will is ineffectual.

Conclusions: In every case, regardless of the thematic emphasis within the broad subject of food security and nutrition, and sustainable diets, urgency of action is the common, but heretofore neglected, call. The Covid-19 epidemic, and the recent glimpses of a global conflict, have sharpened the focus on the imperative of urgency related to food security and nutrition.

Keywords: science-policy, Sustainable diets, Food security, nutrition, High Level Panel of Experts

Conflict of Interest Disclosure: No conflicts

Annals of Nutrition and Metabolism

Panel Discussions

PD1-1
COVID-19, Food and Nutrition in the United States of America

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In the United States of America (USA) government response to the COVID-19 pandemic included Legislation (Families First Coronavirus Response Act, FFCRA, in 2020 and the American Rescue Plan of 2021). Even prior to COVID-19, poor diet was the leading underlying cause of death in the USA, though disparities exist. This paper reviews literature describing the COVID-19 food- and nutrition-related response in the USA. Electronic literature searches on PubMed and Web of Science search engines identified information related to the USA food- and nutrition-related response to COVID-19 pandemic, until March 2022. Search terms were food, nutrition, COVID, and the United States of America. Papers were reviewed, qualitatively. Key USA food assistance programs leveraged were the Supplemental Nutrition Assistance Program (SNAP), the Supplemental Feeding Program for Women, Infants, and Children, the National School Lunch Program and the Commodity Supplemental Food Program. SNAP increased its benefit and added online application and pandemic electronic benefit transfer options for families. School lunch became free for children. WIC participation increased and WIC innovated for children, though not for women or infants. The Commodity Supplemental Food Program provided food for seniors. Local responses included expanded community food resources and home gardening. Food banks increased food distribution, community and senior centers increased meal distribution. Challenges included panic food buying, food distribution disruptions, a lag in food and unemployment benefits for new applicants, and varying access to nearby healthy food retailers. Disparity in access to benefits was found. School meal participation decreased during the pandemic. Young children experienced increased BMI. There was an increase in consumption high-sodium foods, home-prepared foods, consumption of sweets, red and processed meats, and refined grains and decreased consumption of whole fruits, vegetables, and lean proteins. Households with young children and seniors experienced greater food insecurity, as did households located in areas with low food access. Obesity and obesity-related chronic diseases were associated with severe outcomes from COVID-19. Households experiencing food insecurity had higher rates of COVID-19 infections compared to food secure households. Misinformation led to use of unproven methods to prevent and treat COVID. Successes related to developing “grab and go” school meal options, and adaptability of community food distributions, and online acceptance of SNAP benefits. In the USA, COVID food- and nutrition-related response focused on food assistance, income assistance and housing assistance. Improved resiliency is needed- in coordination and addressing vulnerabilities in global food supply chains, access to local foods, and surveillance systems, for both emerging infections and food systems.

Keywords: COVID-19, Food, Nutrition, United States of America.

Conflict of Interest Disclosure: none

PD1-2
COVID, Food and Nutrition in Indonesia

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While struggling to address long-standing food security and nutrition challenges, Indonesia is facing an unprecedented crisis triggered by the COVID-19 pandemic. Actions are required on many dimensions of food security and nutrition to address the impact of the pandemic on food security and nutrition. This report is based on the latest secondary data available, updates on relevant policies and programs related to food security and nutrition, and new challenges, especially the rise of the triple burden of malnutrition. To control the pandemic, Indonesia implemented an activity restriction policy in 2020 called the large-scale social restriction (PSBB), and in 2021 the emergency public activity restriction (PPKM), involving multi stakeholders' collaboration. Some regencies and districts applied PPKM, based on the severity of Covid-19 cases. Thirty-four ministries and agencies served on a task force team to accelerate the COVID-19 response. All 34 provinces and 496 out of 514 districts-municipalities developed regional task forces. Several private organizations contributed by managing volunteer recruitment for medical services, financial donations, water sanitation and hygiene (WASH) logistics, and coordination support. Non-governmental organizations, United Nations agencies, and universities collaborated to control the pandemic. Seven priority areas identified were health, risk communication, community engagement, logistics, food security, mitigating the socioeconomic impact of the crisis, critical multi-sectoral services, and protection of vulnerable groups. In 2020, the Ministry of Health reported that only 19.2% of Public Health Centers continued to run the Government Integrated Health Post program. Furthermore, the latest available data from the National Nutritional Status Survey showed that there were increasing cases of underweight in children under five, from 16.3% in 2019 to 17.0% in 2021. According to the study of status and determinants of food insecurity and undernutrition in urban

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

poor areas of Jakarta (SDFU, 2020), households experienced reduced income during the pandemic, moderate or severe food insecurity, used some form of coping strategy (using savings, relying on informal debt, selling household assets and goods). Households with children under five dramatically altered how they purchased food due to COVID-19. Food affordability was cited as a greater concern for households than food access and mode of purchase or delivery. Household food insecurity during COVID-19 exacerbated the poor quality of women's diets. Also, children ate fewer nutritious foods and unhealthy foods due to limited household purchasing power. Besides healthy food and diet promotion, the government published guidance on the use of herbal and multi-vitamin-mineral supplements to maintain and improve immunity. Additionally, the government took action to mitigate the impact of the pandemic on food security with food production, that is with home gardening and micro-credit programs to boost micro and small enterprise businesses. Several social assistance programs were established, such as cash transfer, basic foods, village-level direct cash assistance, and electricity subsidy. These programs resulted in positive impacts in easing the burden of the pandemic. The social safety net programs should be extended, and efforts to maintain a good health system, food supply, and price stabilization should be continued.

Keywords: Covid-19, Nutrition, Food, Indonesia

PD1-3
COVID-19, Food and Nutrition in Thailand

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1. Mahidol University (Thailand)

Thailand has successfully contained the first wave of COVID-19. A national strategy for responding to COVID-19 was implemented with surveillance at three levels. The surveillance included points of entry into the country, hospitals and healthcare facilities and active case finding in the community by village health volunteers and related agencies from both the public and private sectors. Risk communication preparedness involved continually assessing risks and monitoring people's behaviors to develop appropriate communication strategies and messages for all populations, age groups, sexes and both Thais and non-Thais. Social media played a crucial role in raising awareness of the general public regarding the dangers of COVID-19. Using information technology in tracing COVID-19 was developed to record population movement data for the benefit of contact tracing among risk groups and bringing them into the disease surveillance and investigation process.

The COVID-19 outbreak and the control measures affected risk behaviors and future non-communicable disease among Thai people. An online survey in 2020 was performed to assess 7,711 people from 77 provinces. People had more stress and gained weight (31.7%). The factors resulting in weight gain were eating more food including instant noodle, dessert, sugar sweetened beverage, fruit and less physical exercise. However, they were increased focus on herbs and local remedies. The government of Thailand approved green chiretta (*Andrographis paniculata*) and fingerroot (*Boesenbergia rotunda*) to treat early symptoms and reduce the severity of COVID-19.

United Nations expect COVID-19 had an impact on food and nutrition security in the short and long term. The long-term impact will likely be most pronounced in children who were in the first 1,000 days of their lives during the pandemic. The supply-side shocks, the availability and prices of food, have been a concern in the short term. On the demand side, a decrease in purchasing power is likely to affect the quality of diets and access to nutrition services. The closure of schools put a further strain on households where children depend on school meals for lunch. These changes in dietary quality can reduce nutrient intake, which can lead to micronutrient deficiencies in women and children, and worsening of wasting among children who are at or near the cut-off for wasting, and stunting in children under five. These impacts will be felt most by the urban poor and informal sector workers and migrant labor households who are most vulnerable to the economic shocks associated with COVID-19. At the same time, consumption of foods that are rich in fat and sugar has risen among households in urban areas. These dietary changes, combined with a reduction in physical activity could increase the risk of obesity and developing NCDs, an existing public health concern in Thailand across age groups. Food security strategies among communities during the pandemic were (1) food banks (the growth and consumption of organic vegetables, the paddy rice fund), (2) food exchanges (exchanging rice and fish), and (3) food pantries (food donation). Policy choices should address food and nutrition security, and center on the health system, the food system, and food and nutrition surveillance.

Keywords: COVID-19, Food, Nutrition, Thailand

Conflict of Interest Disclosure: No-

PD1-4
COVID-19, food, and nutrition in Japan

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Japan`s outbreak of the COVID-19 epidemic started in April 2020 (first wave), and in January 2022, the epidemic of Omicron strains (sixth wave) occurred. As a result of the later start to the epidemic, the number of infections and deaths are likely to be lower than other countries. However, the epidemic has deepened health disparities. Early in the epidemic (2020 April and May), office workers worked from home and most of the schools closed. According to the Household Survey (Ministry of Internal Affairs and Communication), household consumption of rice, pasta, and frozen foods temporarily increased during this time. Relatedly, the restaurant industry showed a severe sales decline during this time. Studies in Japan showed that, during the pandemic, groups working at home were more likely to have a higher income and education, a temporary deterioration in physical activity, and increased bodyweight. In another study, participants whose income decreased showed a higher

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

frequency of using takeout food. Most studies were online surveys, which very low-income groups might not have responded to. Regional level study showed that high unemployment rates, or high restaurant industry workers per prefecture rate, was related to higher mortality rates. Service industry workers have a higher risk of infection and low-income groups tend to have a higher risk of chronic diseases that affects mortality from COVID-19 infections. Children`s studies showed increase in screen time, both increase or decrease of body weight and decrease of physical strength. A food survey of elementary school children found that a "well balanced dietary intake" - the intake of dairy products, meat, fish, eggs, vegetables, and fruit – was low in all income groups (quartiles) and was the lowest in the lowest- income group. In Japan, there are various support funds for people in need and a child rearing allowance for single parents, though there is no funding directly protecting food security. Single parent surveys showed that many are limiting the amount of food or frequency of feeding. And though they have many problems, they are feeling difficulty asking others for help. In the long term, measure, encouraging food literacy from young age, through school meal programs and nutrition education might narrow the disparity. All children could experience healthy food, have knowledge of nutrition and practice basic cooking skills. In the short term, packing school lunch to take out like the “grab and go" program in the U.S, in school closure or in long vacations, are affordable ways to provide food to children. For adults, collaboration between public and private sectors may be needed in order to have contact with people in need, as there is no specific place to contact them in a way that protects personal information. Food supplies can be through volunteer groups, local children's cafeterias or food banks. In addition to providing food, teaching cooking, may be a way to develop food literacy for the adult group. Japan experienced worsened health and food disparities. A food system which can reach all, leaving no one behind, is needed.

Keywords: COVID-19, Food, Health, Disparity, Japan

PD2-2
Omega-3 Fatty Acids for Depression: Recent Finding

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Background: Omega-3 fatty acids have demonstrated promising efficacy for treating depressive disorders, but there is still limited consensus on optimal formulations, doses, and target populations. Given the anti-inflammatory properties of omega-3s, they may be well suited for individuals with depression and high inflammation states, including being overweight or obese.

Methods: We compared clinical efficacy and biological effects of three eicosapentaenoic acid (EPA) doses versus placebo on inflammatory biomarkers, depressive symptoms, and EPA metabolites and resolvins (Rv) E1-3. We randomized 61 unmedicated adults (75% female; 45.5 +/- 13.8 years) with DSM-5 major depressive disorder (MDD), body mass index (BMI) >25 kg/m2, and plasma high-sensitivity C-Reactive Protein (hs-CRP) >=3.0 mg/L to EPA 1 g/day, 2 g/day, 4 g/day or placebo for 12 weeks. We hypothesized an EPA-related effect size (ES) >= 0.40 for decrease in plasma interleukin (IL)-6, peripheral blood mononuclear cell (PBMC) cytokines, and lipopolysaccharide (LPS)-stimulated tumor necrosis factor (TNF) production. Response was defined as a >=50% decrease of Inventory of Depressive Symptomatology, Clinician-Rated version (IDS-C30) scores. We also hypothesized an EPA-related ES >= 0.35 at weeks 8 and 12 for decrease in IDS-C30 scores or a sustained effect on IDS-C30 response rates at weeks 8 and 12, and that changes in hs-CRP, IL-6 and LPS-stimulated PBMC TNF production would be associated with depressive improvement.

Results: In 45 completers, only median PBMC TNF decreased at 2 g/day EPA. No EPA dose produced a >= 0.35 ES reduction in plasma IL-6 or mitogen-stimulated TNF. Response rates were 64% for EPA 4 g/day and 40% for placebo (odds ratio [OR]= 2.63; Cohen d = 0.53), 38% for EPA 1 g/day and 36% for EPA 2 g/day (P>0.05 for all comparisons). EPA 4 g/day showed a significant correlation between percent decrease in plasma hs-CRP and IDS-C30 symptom reduction at 12 weeks (Spearman rho=0.691, p=0.019). In 42 patients with available EPA and resolvin data, plasma EPA and EPA-derived metabolite concentrations remained unchanged in the placebo group. Plasma EPA and metabolites, including 18-hydroxyeicosapentaenoic acid (18-HEPE), which is the precursor of resolvins RvE1-3, increased significantly and dose-dependently in all EPA supplementation arms. RvE1 was undetected in all treatment groups, while RvE2 and RvE3 increased dose-dependently. Arachidonic acid-derived lipoxin B4 (LXB4) also increased in the 4 g/day arm.

Conclusions: EPA 4 g/day demonstrated a medium effect size for response rates compared to placebo and may alleviate MDD in overweight adults with high inflammation; hs-CRP may be associated with clinical response. EPA 4 g/day also produced a robust increase in plasma EPA and 18-HEPE, which may promote conversion to RvE2 and RvE3, and LXB4. Their associations with reduced inflammation and clinical improvement remain to be clarified.

Conflict of Interest Disclosure: Dr Mischoulon has received research support from Nordic Naturals and heckel medizintechnik GmbH. He has received honoraria for speaking from the Massachusetts General Hospital Psychiatry Academy. He also works with the MGH Clinical Trials Network and Institute (CTNI), which has received research funding from multiple pharmaceutical companies and NIMH.

Keywords: Omega-3, eicosapentaenoic acid, Depression, Overweight, Inflammation

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PD2-3
Role of Omega-3 Polyunsaturated Fatty Acids in Perinatal Depression

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Omega-3 polyunsaturated fatty acids (hereafter, omega-3) such as DHA are important constituents of the brain and nerves, and they are required in large amounts, especially during pregnancy and lactation. However, omega-3 cannot be synthesized in the body, so it must be obtained from food. According to a postmortem brain study of fetuses, the daily requirement was estimated to be 67 mg in the third trimester of pregnancy (Clandinin MT, et al 1981). A cohort study in Germany showed a negative correlation between weeks of gestation and months of lactation and omega-3 in blood (Gellert S, et al 2016). When there is inadequate intake of omega-3, animal experiments have shown that mother rats supply omega-3 to their fetuses even at the expense of their own brain (Levant B, et al 2006). MRI studies have shown that the cerebral volume of healthy mothers during a singleton pregnancy does in fact decrease by about 4%-6% by the time of delivery, before returning to its original volume after delivery (Oatridge A, et al 2002). One possible reason for the volume reduction is the supply of n-3 polyunsaturated fatty acids to the fetus. Thus, if insufficient omega-3 is consumed during pregnancy, neuropsychiatric disturbances may affect both mother and child. Analysis of a large dataset obtained in an ongoing birth cohort study conducted by the Ministry of the Environment in Japan— the Japan Environment and Children's Study (JECS) involving around 100,000 representative pregnant women— revealed lower odds ratios for depression in mid-late pregnancy and after delivery in women who had higher intakes of fish and omega-3 during pregnancy (Hamazaki K, et al 2018, 2020). Different fish contain different amounts of methylmercury, which can have adverse neurodevelopmental effects. Large fish bioaccumulate larger amounts, whereas smaller fish do not have levels for concern, such as yellowfin tuna, salmon, sardines, yellowtail, albacore, horse mackerel, Pacific saury, bonito, Pacific bluefin tuna, mackerel, and sea bream (Ministry of Health, Labour and Welfare). According to the National Health and Nutrition Survey, fish consumption is consistently declining in Japan. This is occurring alongside decreasing amounts of omega-3 in Japanese mother's breastmilk over the last three decades (Yoshida S, et al 2019). Fish is rich in minerals, vitamins, high-quality protein, and omega-3, and therefore in this symposium we will discuss the importance of fish consumption in pregnancy.

Keywords: Omega-3 polyunsaturated fatty acids, Perinatal Depression, Fish

PD2-4
The Interplay of Stress, Inflammation, and Omega-3 PUFAs in Depression

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The increasing global burden calls for the development of novel approaches to tackle unmet needs in prevention and treatment of depression underlying biological, psychological and social dysregulations. Depressed patients with chronic low-grade inflammation might be classified as a subgroup of major depressive disorder (MDD); therefore, looking for antidepressant therapies from anti-inflammatory pathways could improve treatment effectiveness for this subgroup of patients. Omega-3 (or n-3) polyunsaturated fatty acids (PUFAs) are anti-inflammatory both in peripheral organs and central nervous systems and have clinically applied in the treatment and prevention of depression, cardiovascular diseases, dyslipidaemia, diabetes and arthritis. Anthropological studies suggest that human beings evolved to a modern diet with less than one-tenth of omega-3 to omega-6 PUFAs intake ratio, which leads to a constitutional bias toward chronic systemic inflammatory status to explain dramatically increasing of depression and chronic medical illnesses in modern world. The presentation is to provide our recent clinical and pre-clinical studies and an overview about the role of inflammation in “mind-body” comorbidity and present anti-inflammatory mechanisms by which n-3 PUFAs may orchestrate the molecular and cellular functions and facilitate the therapeutic pathways in chronic medical illnesses and depression.

Keywords: depression, inflammation, omega-3
Conflict of Interest Disclosure: N/A
Further Collaborators: N/A

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PD2-5
Fish oil may ease anxiety

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Systematic review and meta-analysis (JAMA Netw Open, 2018) have revealed that omega-3 fatty acids can help relieve symptoms in patients with anxiety disorder. Omega-3 fatty acids didn't help people who did not have specific clinical conditions. Patients who benefited most were those who took 2,000 mg per day or more. Although omega-3 fatty acids is not a first-line treatment for anxiety, for patients who are not responsive to psychotherapies, eating fatty fish might be a promising alternative.

Keywords: anxiety, posttraumatic stress disorder, fish oil, omega-3 fatty acids

Conflict of Interest Disclosure: Matsuoka has received speaker fees from Suntory, Pfizer, Mochida, Eli Lilly, Morinaga Milk, and Cimic.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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Oral Abstract Presentations

OAB(T1)1-1
Artificial sweeteners and risk of cardiovascular diseases in the prospective NutriNet-Santé cohort

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Background and objectives: Artificial sweeteners are widely used today by the food industry as an alternative to sugar, providing sweet taste and nearly no calorie. Potential adverse effects of these food additives on cardiovascular disease (CVD) risk have been suggested in experimental studies, but data from studies involving humans remain very limited. Previous cohorts have focused solely on artificially sweetened beverages. Our objective was to study the associations between artificial sweeteners from all dietary sources (beverages but also table-top sweeteners, dairy products, etc.), overall and by molecule (aspartame, acesulfame-potassium and sucralose), and risk of CVDs (overall, coronary heart and cerebrovascular).

Methods: The study included 103,388 participants of the web-based NutriNet-Santé cohort (2009-2021, mean age=42.2±14.4, 79.8% female, 904,205 person-years). Artificial sweetener intake as well as detailed dietary data were assessed thanks to repeated 24h dietary records, including names and brands of industrial products consumed. Multi-adjusted Cox proportional hazard models were performed. Exposure to artificial sweeteners were coded as three category variables: non-consumers, lower consumers (artificial sweetener intake below the sex-specific median) and higher consumers (above the sex-specific median).

Results: Compared to non-consumers, higher consumers of total artificial sweeteners had increased risk for CVD (n=1502 incident cases, HR=1.17 (1.01-1.35), P-trend=0.04) and more specifically cerebrovascular diseases (n=777, HR=1.34 (1.10-1.62), P-trend=0.004). Higher consumption of aspartame was associated with increased cerebrovascular diseases (HR=1.29 (1.03-1.60), P-trend=0.01). Higher consumption of acesulfame-K was associated with a higher risk of CVD (HR=1.24 (1.04-1.47), P-trend=0.02) and cerebrovascular diseases (HR=1.29 (1.02-1.64), P-trend=0.1). No association was detected for coronary heart diseases (n=730 incident cases).

Conclusions: Findings from this large-scale prospective cohort suggest a direct association between higher artificial sweetener consumption and increased CVD risk, in particular cerebrovascular. These results provide key novel information in a context where artificial sweeteners, present in thousands of food and beverage brands worldwide, are currently undergoing a re-evaluation by the European Food Safety Authority and other health agencies.

Keywords: Artificial sweeteners, Cardiovascular diseases, Prospective cohort, Food additives

Conflict of Interest Disclosure: No conflict of interest.

Further Collaborators: Researchers from public institutions can submit a collaboration request including information on the institution and a brief description of the project to collaboration@etude-nutrinet-sante.fr. All requests will be reviewed by the steering committee of the NutriNet-Santé study. If the collaboration is accepted, a data access agreement will be necessary and appropriate authorizations from the competent administrative authorities may be needed. In accordance with existing regulations, no personal data will be accessible.

OAB(T1)1-2
Fortified milk intake reduces iron, vitamin A, vitamin C, calcium, and B-vitamins inadequacies in Pakistan school-aged children: a diet modeling study

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Background and objectives: While 89% of Pakistani 5-9y old consume dairy products, only 8% comply with Pakistan's recommended dairy intake of 2-3 servings-day (s-d). More than 80% have inadequate intakes of calcium, iron, zinc, and vitamin A. Other main nutrient inadequacies include vitamin C (60%), B-vitamins (around 25%, except for folate 75%). The objective of this study was to evaluate the theoretical impact of adhering to 2s-d dairy recommendations on nutrient adequacy in Pakistani school-aged children.

Methods: Adherence to dairy recommendation was calculated using dietary data collected in 5370 children via a 24–hour diet recall in the School–age Children Health & Nutrition Survey in Sindh and Punjab, Pakistan (SCANS) in 2019–2020. Two modelling scenarios were applied to test the impact on nutrient intakes of a) substituting current milk intake (volume by volume) with a fortified milk beverage and b) adding a fortified milk

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

beverage to current intake to meet dairy intake recommendations. Mean nutrient intakes and percentages of children with inadequate intakes (compared with dietary reference intakes) were estimated before and after applying modelling scenarios.

Results: Among 4452 children consuming milk, the hypothetical substitution of current milk intake with fortified milk lowered nutrient inadequacies for vitamin C (by 89%), riboflavin (by 59%), vitamin A (by 55%), iron (by 31%), thiamin (by 30%), and calcium (by 28%), compared to baseline. Among 4358 children consuming less than 2 dairy s-d, a high percentage of nutrient inadequacies were observed: all children had calcium and zinc inadequacy, 98% iron, 90% vitamin A, and 59% vitamin C. The theoretical addition of fortified milk to current consumption of dairy products nearly eliminated vitamins C and A inadequacies, reduced calcium inadequacy by 7% and iron by 12%.

Conclusions: Substituting usual milk intake with fortified milk can bring additional nutrients that are not typically found in usual (unfortified) milks and help close nutrient gaps such as iron, vitamin A, vitamin C, and B-vitamins inadequacies. In children not adhering to dairy recommendations, increasing dairy with a fortified milk contributes to eliminating nutrients gaps for vitamins C and A and reduce nutrient inadequacies for calcium and iron.

Keywords: diet modelling, nutrient inadequacy, dairy, milk, school-aged children

Conflict of Interest Disclosure: Afeiche MC, Mak TN, Zimmermann D, Donato-Capel L are employees of Société des Produits Nestlé S.A.

OAB(T1)1-3
Irregularity in energy and nutrient intake and its association with BMI and Waist Circumference in adults from the UK National Diet and Nutrition Survey (2008-17) Rolling Programme

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Background and Objectives: Recent evidence suggested that individuals with a more irregular intake of energy, especially during breakfast and between meals, appeared to have an increased cardiometabolic risk. This project aims at finding irregularity eating patterns of energy, free sugars and saturated fats, and investigating their potential associations with measures of obesity.

Methods: Diet diary data repeated over 4 days for 6802 adults aged 19 or older from the UK Nutritional Diet and Nutrition Survey (2008-17) was utilised. Irregularity score of energy, free sugars and saturated fats were calculated for each time slot using mean absolute deviation around the mean (MAD). Principal component analysis (PCA) on the correlation matrix was applied to derive irregularity eating patterns (IEP) of energy, free sugars and saturated fats intake. Multivariable regression models accounting for the complex survey design were used to assess the association between the derived IEP and body mass index (BMI) as well as waist circumference (WC).

Results: Three orthogonal IEP were identified for each of type of nutrient and for each the first principal component (IEP1) was defined as an average level of irregularity across the day for that specific intake. The other principal components for energy were interpretable as (ii) a linear contrast between irregularity at main meal and irregularity at snack-time and (iii) irregularity in the day vs irregularity in the night. After adjustment for confounders, every 1 unit increase in IEP1 of energy intake was significantly associated with 0.38 kg/m2 and 0.86 cm increase in BMI and WC, respectively. Increase in overall IEP of free sugars and saturated fats were significantly associated with an increased level of BMI. In women only, a unit increase in overall irregularity score for saturated fat was associated with a 1.07 cm higher WC.

Conclusions: Adults who tended to have a higher irregularity in energy intake, free sugars and saturated fats had higher average BMI and WC. Women who had an overall irregular intake of saturated fats tended to have a higher WC. Further research should seek to identify the determinants of IEP establishing the causal relations with obesity via prospective study designs.

Keywords: chrononutrition, irregular energy intake, nutrition survey, principal component analysis, saturated fats

Conflict of Interest Disclosure: None

OAB(T1)1-4
Dietary acid load, cardiometabolic syndrome and bone resorption among postmenopausal Malaysian Chinese women

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Background and objectives: Studies showed that acidic diet dominated by animal sources and low in vegetables and fruits, can lead to chronic metabolic acidosis and thus cause calcium loss from bone. Despite acid-base balance theory hypothesized habitual consumption of high dietary acid load (DAL) is associated with a higher risk of osteoporosis, the scientific evidence has been inconsistent. Thus, this study aimed to explore the effects of DAL and cardiometabolic syndrome (CMS) and their potential interactions on bone resorption rate.

Methods: This cross-sectional study recruited 211 postmenopausal women in community settings. DAL was estimated using potential renal acid load from food frequency

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

questionnaire. Sleep quality was assessed using Pittsburgh Sleep Quality Index (PSQI). Serum levels of 25(OH) vitamin D was determined by using the ADVIA Centaur VitD assay and serum collagen type 1 cross-linked C-telopeptide (CTX1) was used as a surrogate bone marker to assess bone resorption. Cardiometabolic syndrome was determined according to Harmonized criteria.

Results: Results showed that age (β = -0.145, t = -2.002, p <0.05) was negatively associated while DAL (β = 0.142, t = 2.096, p<0.05) while sleep quality (β = 0.147, t = 2.162, p<0.05) and height (r = 0.136, p<0.05) were positively associated with CTX1. On the other hand, other variables (CMS traits, CMS, serum of 25(OH), years of menopause, years of education and physical activity) were not significantly associated with CTX1. There was no significant interaction effect between DAL and CMS on bone resorption.

Conclusions: Current findings proposing high DAL, but not CMS, is a potential risk factor for bone resorption. This study does not support the interaction effect of DAL and CMS on bone resorption but provides scientific insight on how acidic diet may influence bone resorption rate. Appropriate planning for preventing or delaying the onset of osteoporosis among postmenopausal women is highly warranted.

Keywords: Dietary acid load, cardiometabolic syndrome, bone resorption, postmenopausal women

OAB(T1)1-5
Discovery of metabolite biomarkers of meat consumption and their association with incident type 2 diabetes in a Swedish population-based cohort

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Background and objectives: Biomarkers of different meat intakes, complemented with self-reported intake, could clarify their yet inconsistent associations with incident type 2 diabetes (T2D). We aim to discover potential plasma metabolite biomarkers for intake of various meat food groups, and to investigate their associations with the risk of developing T2D. **Methods**: Self-reported meat intake, covariates, and fasting plasma samples were from a case-control study nested within the prospective Västerbotten Intervention Program (VIP), including 403 randomly selected participants who developed T2D (median 7 years to diagnosis) and matching controls. We used random forest on untargeted LCMS metabolomics data (24758 features) to discover biomarker candidates to reflect the intakes of total-, processed-, and unprocessed meat, as well as poultry. Selected features were adjusted for age, sex, and total energy intake using partial Spearman correlation with meat intake. These selected features were further associated to T2D risk using conditional logistic regression, adjusting for age, sex, physical activity, smoking, total energy and alcohol intake. **Results**: Features associated with total- (n=18), processed- (n=67), unprocessed meat (n=29), and poultry (n=53) were identified. Processed meat intake was associated with octenoylcarnitine (r = 0.32, FDR = 1.28 x 10^{-8}), decatrienoylcarnitine (r = 0.24, FDR = 3.40 x 10^{-5}), and inversely with methylproline (r = -0,18, FDR = 0.002). Poultry intake was associated with hydroxyvaleric acid (r = 0.16, FDR = 5.70 x 10^{-3}) and inversely with LPC (17:1) (r = -0.20, FDR = 1.93 x 10^{-3}) and PC(15:0/18:2) (r = 0.18, FDR = 4.09 x 10^{-3}). Interestingly, they were also associated with T2D risk. Octenoylcarnitine (OR 1.41, 95% CI 1.21-1.65, FDR = 1.05 x 10^{4}), decatrienoylcarnitine (OR 1.37, 95% CI 1.17-1.61, FDR = 4.86 x 10^{-4}), and hydroxyvaleric acid (OR 1.60, 95% CI 1.34-1.92, FDR = 3.45 x 10^{-6}) were associated with higher T2D risk, whereas methylproline (OR 0.77, 95% CI 0.66-0.90, FDR = 4.21 x 10^{-3}), LPC(17:1) (OR 0.71, 95% CI 0.61-0.83, FDR = 1.47 x 10^{-4}), and PC(15:0/18:2) (OR 0.73, 95% CI 0.62-0.85, FDR = 4.86 x 10^{-4}) with lower risk. These associations disappeared after adjustments, except for hydroxyvaleric acid (OR 1.47, 95% CI 1.19-1.82, FDR = 0.015). **Conclusion**: We discovered several biomarker candidates of meat intake which were also associated with T2D risk.

Keywords: food intake biomarker, blood metabolites, untargeted metabolomics, meat, type 2 diabetes

Conflict of Interest Disclosure: none declared

OAB(T1)1-6
Revision of dietary reference intake of iodine for Chinese

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Background: The dietary reference intake (DRIs) of iodine is significant in guiding the public scientific iodine supplementation. The 2000 version of the Chinese iodine DRIs standard was derived based on foreign research data. The data on Chinese dietary reference intake of iodine are incomplete and need to be supplemented.

Methods: Summarizing the latest progress of iodine intake in domestic and foreign research to provide evidence for the revision of iodine DRIs.

Results: The adult's iodine tolerable upper intake levels (UL) of 600μg/d in the 2013 version of the iodine DRIs standard is based on the Chinese double-blind iodine intervention experiment. The iodine DRIs data of other populations were derived from foreign studies. Subsequently, Zhang et al.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

conducted a large-scale epidemiological survey on children in areas naturally exposed to different concentrations of water iodine, and found that when iodine intake was greater than 250μg/d and 300μg/d, respectively, the goiter rate in children aged 7-10 and 11-14 was greater than 5%. It is suggested that the iodine intake of children aged 7-10 and 11-14 should not exceed 250μg/d and 300μg/d. Besides, several studies have reported a significant increase in the incidence of subclinical hypothyroidism in pregnant women with urinary iodine concentrations above 250 μg/L. The Iodine balance study in pregnant women suggested that urinary iodine excretion is 1.8 L/d. About 90% of daily dietary iodine intake is excreted in the urine. It is assumed that the upper limit of daily iodine intake for pregnant women is about 500 μg/d.

Conclusions: The 2013 version of the adult's iodine UL was revised based on a randomized double-blind trial of iodine supplementation. New research evidence suggests that children aged 7-10 and 11-14 years old and pregnant women can tolerate upper intake levels of iodine of 250μg/d, 300μg/d and 500μg/d, respectively.

Conflict of Interest Disclosure: The authors declare that they have no potential conflicts of interest.

Keywords: iodine, dietary reference intakes, tolerable upper intake levels

OAB(T1)1-7
Dietary factors and risk of SARS-CoV-2 infection: prospective analyses from the Moli-sani Study Cohort

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Background and Objectives: A healthy and balanced diet plays a major role in supporting the immune system which is critical to protect the host from pathogenic organisms. To date, evidence on the relationship between dietary habits and the risk of SARS-CoV-2 infection is still scarce. **Methods**: Analyses included 1,096 participants from the Moli-sani Study (2005-2010) who were re-examined in 2017-2020, and in January-September 2021. Food intake was assessed in 2017-2020 using a semi quantitative 188-item food frequency questionnaire. Adherence to the Mediterranean diet was evaluated using the Mediterranean Diet Score (MDS) ranging from 0 to 9. Multivariable logistic regression models were used to estimate odds ratios (OR) and 95% confidence intervals (95%CI) for incident SARS-CoV-2 infection in association with the MDS, its individual components and nutritional factors. **Results**: Out of 1,096 participants, 90 either reported to have tested positive for COVID-19 or were positive for anti-SARS-CoV-2 antibodies before receiving any COVID-19 vaccine. In a multivariable-adjusted model including lifestyles, socioeconomic and clinical factors and also accounting for a composite index of behavioural risk factors (e.g. face mask use, hand sanitiser), a 1-point increase in the MDS was associated, though not significantly, with lower risk of SARS-CoV-2 infection (OR=0.90; 95%CI 0.78-1.04). Among individual dietary components, a high consumption of vegetables and fruits and nuts was associated with lower odds of SARS-CoV-2 infection (OR=0.57; 0.34-0.96 and OR=0.61; 0.37-1.00, respectively). High fish intake was otherwise linked to increased risk of infection (OR=2.05; 1.25-3.36). Nutritional factors associated with reduced risk of infection were dietary fibre (OR=0.50; 0.27-0.93 for 10 g/d increase), vegetable proteins (OR=0.56; 0.33-0.94 for 10 g/d increase) and vitamin C (OR=0.94; 0.89-0.99 for 10 g/d increase). **Conclusions**: Global adherence to the Mediterranean Diet was suggestive of a lower risk of SARS-CoV-2 infection. In particular, large amounts of fruit and vegetables were associated with reduced odds of being infected, as well as diets rich in fibre, vegetable proteins and Vitamin C. The greater risk associated with high fish intake deserves further investigation.

Keywords: Mediterranean Diet, Dietary factors, SARS-CoV-2 infection

Conflict of Interest Disclosure: None.

Further Collaborators: None.

OAB(T1)2-1
Association between dietary behaviors and BMI modified by the *ALDH2* rs671 polymorphism

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Background and objectives: The rs671 polymorphism in the aldehyde dehydrogenase (*ALDH2*) gene is unique to East Asians. This polymorphism has recently been reported to be associated with several dietary behaviors (DBs) as well as BMI. Therefore, this study aimed to determine whether the effect of DB on BMI is modified by rs671.

Methods: A total of 12,271 Japanese participated in this study. Data from rs671 genotypes from single nucleotide polymorphism arrays and 54 DBs from self-reported online surveys were used. All analyses were stratified by participants' sex. First, linear regression analyses were performed to investigate whether each DB was associated with BMI. Next, linear regression analysis and heterogeneity tests were used to investigate whether the rs671 polymorphism modified the effect of each DB on BMI. Finally, stepwise regression analysis was used

to examine the association between rs671 genotype and drinking habit-specific DBs and BMI.

Results: A total of 33 DBs were significantly associated with BMI for each sex. Genetic heterogeneity was found in all subgroups of participants, including drinkers and non-drinkers. Furthermore, stepwise regression analysis revealed that these associations between DBs and BMI were characterized differently according to sex, drinking habits, and rs671 genotype. In particular, the association characteristics between DB and BMI in drinkers were similar between rs671 genotypes, whereas in non-drinkers, they were not similar across genotypes. Furthermore, a positive association was observed between lactobacillus beverages and BMI in the AA genotype.

Conclusions: This study suggests that the association between DBs and BMI was modified by rs671 polymorphism. Our findings will contribute to the precision nutrition for health maintenance in East Asians.

Keywords: ALDH2 rs671 polymorphism, Dietary behaviors, BMI, Precision nutrition, Japanese

Conflict of Interest Disclosure: KH is a member of the Social Cooperation Program funded by Ajinomoto Co. SN is an employee of Genequest Inc.ST and KS are Board Members of Genequest Inc. TH is a Board Member of Genome Analytics Japan Inc. and is an adviser of Genequest Inc.

OAB(T1)2-2

Elucidation of the causal role of iron deficiency and excess on anemia and on cardiometabolic syndrome in UK White and Taiwan Han Chinese ethnic groups using Mendelian randomization analysis

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Background and objectives: Anemia due to iron deficiency remained to be a global public health problem, while several epidemiological studies have implicated elevated iron levels with higher risk of cardiometabolic outcomes. Genetic susceptibility and environmental factors were reported to cause both anemia and a number of cardiometabolic outcomes. However, there has been scarcity of data on the susceptibility genes of iron status, especially among non-European populations. It is also not completely clear whether variants of iron homeostasis genes causally influence the development of cardiometabolic syndrome (CMS). Through Mendelian Randomization (MR), our study elucidates the causal effects of iron deficiency and excess in precipitating the risk of anemia and CMS, respectively.

Methods: We first conducted genome-wide association studies of blood hemoglobin (Hb) concentration among UK Whites and Taiwan Han Chinese (HC). Ethnic-specific genetic risk scores from Hb-associated SNPs (Hb-GRS) were then constructed as instrumental variables for iron status. In our MR analyses, we performed multivariate logistic regressions that investigated the causal associations between tertiles of Hb-GRS, CMS, and cardiometabolic outcomes.

Results: Consistent genome-wide Hb-association of SNPs in *TMPRSS6* (chr 22), *ABO* (chr 9), and *PRKCE* (chr 2) were observed across sexes in both ethnic groups. Specific to the Taiwan HC, the Hb-association with *AXIN1*, together with other loci near the chr 16 alpha-globin gene cluster, was found novel. On the other hand, majority of the Hb-associated SNPs among Europeans were identified along the chr 6 major histocompatibility complex region, which has established roles in immune system control. We then found evidence to support causal associations between increasing tertiles of Hb-GRS and risks for CMS, hypertriglyceridemia, hypertension, diabetes mellitus, overweight and obesity, and hyperuricemia in the Taiwan HC group. We were able to cross-validate the causal associations in the UK Whites.

Conclusions: Such findings suggest the causal role of elevated iron levels in the pathophysiology of metabolic dysfunctions. In addition, the genetic determinants of iron identified among Taiwan HC and UK Whites may be utilized to screen high-risk subgroups for poor iron nutrition and iron overload. These will pave the way for precision nutrition and improve public health in the near future.

Keywords: Genome-wide association study, Iron status, Mendelian randomization, Taiwan Han Chinese, UK White

Conflict of Interest Disclosure: None.

Further Collaborators: None.

OAB(T1)2-3

Vasorin as a new potential biomarker of metabolic risk in children with obesity and insulin resistance.

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Background and objectives: Puberty is a time of metabolic and hormonal changes, and it is associated with a reduced insulin sensitivity that recovers at puberty completion in only some children, but not in all. Indeed, our group has demonstrated that IR represents the core in the pathophysiological development of metabolic syndrome in children with obesity. Preliminary epigenetics and transcriptomics data from our group reveal that the gene

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

encoding vasorin (*VASN*), among others, is significantly more methylated (cg00041083) and lower expressed in blood leukocytes of children with IR along with puberty. Therefore, our aim is to get a deeper understanding of the underlying metabolic architecture of IR development in childhood obesity and to study the pathophysiological implication of VASN as a putative predictive biomarker in children with obesity. **Methods:** The study population is a sub-cohort of the PUBMEP research project, consisting of a longitudinal population of 90 pre- and pubertal children with overweight, obesity and normal weight (53 girls). All subjects were classified into experimental groups according to their sex, obesity and insulin resistance (IR) status. They counted on anthropometry, glucose, and lipid metabolism, inflammation and cardiovascular biomarkers as well as VASN serum levels measured. Moreover, a cross-sectional population of 31 children between 6 and 12 years old were recruited. 15 of them were obese and 15 normal-weight at prepubertal age. Visceral adipose tissue (VAT) biopsies were extracted for genome-wide expression analysis and qRT-PCR. VASN expression was determined in the VAT.

Results: Serum VASN protein levels are significantly lower in children with obesity and insulin resistance, both at the prepubertal and pubertal stage. In addition, the gene expression of *VASN* in visceral adipose tissue is decreased in prepubertal children with obesity, indicating a possible relationship between the gene expression in adipose tissue and the observed lower levels of VASN in blood.

Conclusions: These findings exhibit that VASN may be an important biomarker of metabolic status in children with obesity and insulin resistance. Further analysis are needed in order to understand the molecular mechanism of this protein in adipose tissue, as the main metabolic organ involved in obesity and insulin resistance.

Keywords: Obesity, Metabolism, insulin resistance

Conflict of Interest Disclosure: The authors declare no conflict of interests

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OAB(T1)2-4
Blood DNA methylation signature of 3 dietary patterns

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Background and objectives: Diet is often mentioned as a key modifier of epigenetic markers, but the association between dietary patterns and DNA methylation has been little studied. We aimed to discover differentially methylated CpG sites across the whole genome associated with 3 dietary patterns in healthy adults.

Methods: In 4 cohorts from Spain, US and UK, including a total of 5339 adults, diet quality was measured using 3 different scores: Mediterranean diet score, the Dietary Approaches to Stopping Hypertension (DASH) score, and Healthy Plant-based Dietary Index. We performed epigenome-wide association studies of leukocyte-derived DNA methylation over 469,761 CpGs, adjusted for age, sex, smoking, total energy intake, blood cells and technical variables in every cohort and meta-analysed the results. We selected those CpGs associated with diet scores with a False Discovery rate of 0.05 (corresponding to a p-value of 10^{-6}) and no or low heterogeneity between cohorts (I^2<50%). We used Mendelian Randomization for those CpGs with a genetic instrument (cis-meQTL) to assess a potential causal relationship with cardiometabolic traits.

Results: We discovered of 154 unique differentially methylated CpGs, associated with 3 dietary patterns: the Dietary Approaches to Stop Hypertension (DASH, 92 CpGs), the Mediterranean diet (41 CpGs), and a Healthy Plant Based Diet (49 CpGs), and 24 were common to two or three of these dietary patterns. When applying a stricter threshold (Bonferroni correction), there were 21 CpGs. We replicated 3 CpGs associated with Mediterranean diet or Healthy Eating Index in a previous publication, which were annotated to SNORA54, NAP1L4, SOCS3 and BCL3 genes. When adjusting for body mass index and physical activity, the association was attenuated by more than 15% for 44 CpGs. In MR, we found that 2 diet-related CpGs were likely causally associated with body mass index, 1 CpG with CVD and 2 CpGs with diabetes.

Conclusions: We discovered 151 novel CpGs differentially methylated associated with 3 healthy dietary patterns. The majority of these CpGs are involved in cardiometabolic ways, and some appear causally associated with adiposity, CVD and diabetes.

Keywords: Epigenetics, DNA methylation, Dietary patterns

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T1)2-5

MicroRNAs from plants can potentially modulate human gene expression in the context of obesity

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Background: MicroRNAs (miRNAs) have gained special attention due to their potential role as cross-kingdom gene expression regulators. Dietary plant miRNAs, which have been termed as xenomiRNAs, could be absorbed and reach specific tissues and organs, in which they might modulate gene expression and shape subject physiology. In addition, xenomiRNAs could be a key mechanism by which dietary patterns might influence metabolism and energy homeostasis. However, several studies refute this hypothesis, suggesting that xenomiRNAs would not be absorbed and display any function on the individuals.

Objectives The main objective of the present work is to determine the interaction between dietary xenomiRNAs and human genes involved in the pathophysiology of obesity and associated comorbidities.

Methods: RNA was isolated from plant foods (legumes, vegetables, nuts, fruits) and serum and faecal samples, before and after an acute ingestion (over 3 days/72 h) of plant-derived products. NGS was performed and plant conserved miRNAs and isoforms were identified. MiRNA candidates were selected according to their abundance, presence in human samples and potential interaction with obesity-related genes. Functional analysis of plant miRNA mimics were carried out in cell cultures (enterocytes, hepatocytes and macrophages), in which expression of target genes and their biological impact were evaluated.

Results: The results suggest that plant-derived miRNAs are abundantly present in vegetables, legumes, fruits and nuts. These miRNAs are detected in human samples and their relative amount increase after an acute ingestion. They also down-regulated specific human genes, whose dysregulation has been associated with obesity onset and/or progression, and displayed a biological relevance. For instance, miRNA156f-3p and miRNA-156f-5p targeted *SMAD4* and *HIF3A* genes, respectively.

Conclusions: Plant foods are rich in miRNAs that resist degradation during digestion, being detected in human samples. In addition, dietary habits reflect the plant miRNA expression profile in human samples. XenomiRs could be eventually internalized to systemic level and could modulate the expression of target genes related to weight balance. Plant xenomiRNAs could be an underlying mechanism by which dietary patterns influence obesity and metabolic disorders outcome, and thus, they could be potential therapeutic targets for obesity treatment and/or biomarkers of dietary response.

Keywords: Plant xenomiRNAs, Biomarkers, Vegetables, Metabolism, Nutrition

OAB(T1)2-6

Interaction between genetic predisposition and food or beverage intake for incident type 2 diabetes: European Prospective Investigation into Cancer (EPIC) InterAct case-cohort study across 8 European countries

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Background and objectives: There is limited conclusive evidence on whether a person's genetic characteristics modify the relationships between foods and beverages intake and risk for developing type 2 diabetes (T2D). We investigated the interaction between genetic susceptibility and intake of foods and beverages on the risk of developing T2D.

Methods: This prospective study included 9,542 case participants with incident T2D and a subcohort of 12,477 individuals nested within 340,234 participants from eight European countries: European Prospective Investigation into Cancer (EPIC)-InterAct case-cohort study. Genetic risk scores (GRSs) for higher body mass index, insulin resistance and T2D were constructed. Fifteen dietary variables associated with T2D according to published meta-analyses were examined as exposures: fruits, green leafy vegetables, root vegetables, wholegrains and non-white breads, legumes, nuts and seeds, fermented dairy, red meat, processed meat, fish, eggs and egg products, sugar sweetened beverages, coffee and tea. We investigated interactions for each combination of GRS and dietary exposure on T2D incidence using Prentice-weighted Cox regression models fit within each country; estimates were pooled across countries using random-effects meta-analysis.

Results: After accounting for multiple testing, no evidence of statistical interaction was found between any of the GRSs and foods or beverages on either a multiplicative or additive scale.

Conclusions: Genetic susceptibility to higher BMI, insulin resistance or T2D did not modify the association between food or beverage intake and T2D incidence in European populations.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

These findings suggest that currently for the prevention of T2D, stratification of existing population-wide food-based dietary guidance by genetic risk for these metabolic traits is unwarranted.

Keywords: Diet, Genetic Risk Score, Diabetes, Interaction
Conflict of Interest Disclosure: None
Further Collaborators: N/A

OAB(T1)2-7
Multi-ethnic population-based nutrigenetic studies of obesity: Towards implementing precision nutrition in lower middle-income countries

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Background and Objectives: The ability of Nutrigenetics and Nutrigenomics to determine what nutrients will produce the desired impact on metabolic balance is at the core of Personalized Nutrition. Individuals differ from each other in their genetic makeup due to which individuals respond differently to various dietary factors. Obesity is a heritable trait that arises from the interactions between multiple genes and dietary factors. Although studies in developed countries have examined these interactions extensively, there are no such studies in lower middle-income countries (LMICs). Nutrigenetics has highlighted the complexity of gene-nutrient interactions, but it offers opportunities to re-evaluate criteria used to set dietary guidelines and the contribution of genetic variation to optimal nutrition for individuals from different ethnic groups.

Methods: To address this missing gap in nutrition science in LMICs, a large-scale collaborative project called GeNuIne (Gene Nutrient Interactions) Collaboration that aims to develop personalised nutrition strategies based on the evidence from nutrigenetic and nutrigenomic studies using cohorts from various ethnic groups has been initiated. In this large-scale collaborative study, gene-nutrient interactions on obesity across multiple ethnic populations such as India, Sri Lanka, Indonesia, Brazil, Ghana, Turkey, Malaysia, Pakistan, Thailand, and Peru are being examined. A genetic risk score analysis was used to examine the combined effect of several genetic variations on obesity-related traits.

Results: While diets high in saturated fatty acids have been shown to increase the genetic risk of obesity in Western and African populations, diets high in carbohydrates and animal proteins were found to increase the genetic risk in South Asians, Southeast Asians and West Asian populations. Furthermore, in Sri Lankan, Indonesian and Brazilian populations, those carrying a high genetic risk for B12 deficiency had an increased risk of metabolic diseases under the influence of dietary protein, fibre, and carbohydrate intakes, respectively; however, in Asian Indians, genetically instrumented metabolic disease risk showed a significant association with low vitamin B12 status.

Conclusion: In summary, these nutrigenetic studies highlight the existence of genetic heterogeneity in gene–diet interactions across ethnically diverse populations, which further implicates the significance of precision nutrition approaches for the prevention and management of obesity.

Keywords: Nutrigenetics, Gene-diet interactions, Precision Nutrition, GeNuIne Collaboration, Lower-Middle Income Countries
Conflict of Interest Disclosure: None.
Further Collaborators: Collaborators involved in theGeNuIne (Gene-Nutrient Interactions) Collaboration project

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OAB(T1)2-8
Effect of nutrition, TNF-α -308G>A, and TNFRSF1B 196T>G polymorphisms to the susceptibility of type 2 diabetes mellitus in rural Thais: A cohort study

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Background and objectives: Dietary habits and a sedentary lifestyle are major factors for type 2 diabetes mellitus (T2DM). Inflammation also affects its pathogenesis as well as the genetic variation of TNF-α and its receptor. This study aimed to investigate the impact of nutrition, TNF-α (rs1800629), and TNFRSF1B (rs1061622) polymorphisms on T2DM in rural Thais.

Methods: This 2-year follow-up study recruited 248 non-diabetes subjects aged 35-70 years who live in Sung Noen District, Nakhon Ratchasima Province, Thailand. Anthropometry and dietary intake were assessed. TNF-α concentrations were determined using ELISA. Single nucleotide polymorphisms of TNF-α (rs1800629) and TNFRSF1B (rs1061622) were identified by PCR-RFLP.

Results: After the 2-year follow-up, 18.6% of the total subjects had developed T2DM. Food patterns between T2DM and the normal group were not different. However, central obesity was found more frequently in the T2DM group. After adjusting for confounding factors, subjects who carry mutant genotype (GA+AA) of the TNF-α gene (rs1800629) were more likely to have a higher risk of T2DM when compared to subjects who carry the wild-type (GG), OR= 2.06 (P = 0.084). The risk of developing T2DM was significantly increased in subjects who carry the variant (TG+GG) of the NFRSF1B gene (rs1061622), OR = 2.53 (P = 0.011). Moreover, the statistically significant differences of TNF-α concentration were found during the follow-up period in this variant group; baseline = 61.55, 1st follow-up = 44.33, and 2nd follow-up = 111.16 pg/mL, (P = 0.009).

Conclusions: This study found that food habits between T2DM and the normal group were quite similar. However, T2DM subjects progressed with more adverse health effects. It may be due to individual genetic alteration. We suggest that the variant

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of TNFRSF1B 196T>G polymorphism is one of the contributing factors to the genetic risk of T2DM in rural Thais.

Keywords: Type 2 diabetes mellitus, Nutrition, TNF-α, TNFRSF1B, Gene polymorphisms

OAB(T1)2-9
The potential effect of Artificial Sweetener Acesulfame Potassium on Preterm Risk and the activation of Calcium influx via Myosin Light Chain Kinase - Myosin Light Chain 20 related Signaling Pathway

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Background and objectives: The usage of artificial sweeteners has rapidly increased, which may alter human reproduction and pregnancy procedures, but the phenomenon and related mechanisms are still not clear. We aimed to explore the Acesulfame Potassium (Ace K)'s potential mechanism by which it causes uterine contraction through clinical observation and in vitro, ex vivo, and in vivo studies. **Methods**: Used ex vivo study to analyze its effect on uterine contraction and involved signaling pathway. Used in vitro study to evaluate the calcium concentration. Used the long-term, high-dose exposure to examine Ace K's affection on contractive-related protein expression. By involving a cohort of 613 participants, to assess the dose-responsiveness of Ace K consumption, and categorizing the participants into T0-T3. Calculated the odd ratio of Ace K consumption and the relationship with preterm risk.

Results: Animal study showed the increasing uterine contraction ($p<0.05$, n=4-6) where long-term high-dose exposure induced uterine hypercontraction, cytokine secretion and altered contraction-related protein expression. A cohort trial showed that higher consumption of Ace K may be related to the early delivery through the uterine hypercontraction.

Conclusions: Ace K exposure could induce uterine hypercontraction through the modulation of calcium influx and intracellular calcium accumulation, partially related to the c-Jun N-terminal kinase signaling transduction. Long-term and high-dose exposure could enhance oxytocin-induced hypercontraction by increasing oxytocin receptor and myosin light chain kinase - myosin light chain 20 calcium-related signaling pathway. Suggesting that exposure to Ace K may influence the uterine contraction pattern.

Keyword: Acesulfame potassium, Uterine contraction, Calcium influx, Preterm risk

OAB(T1)3-1
Microbiota contributes to the outcomes of caloric restriction by deconjugating bile acids and taurine

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Background and objectives: We showed that caloric restriction (CR) has anti-inflammatory outcomes in the gastrointestinal tract of mice and it triggers an increase in the levels of free taurine, taurine-conjugated bile acids (BA), and other taurine conjugates in intestinal mucosa while decreasing glutathione (GSH) levels. As CR modifies gut bacteria composition, we decided to investigate whether the microbiota is involved in the intestinal response to CR.

Methods: *ad libitum*-fed and CR mice were submitted various treatments: broad-spectrum antibiotics, microbiota transplant, housing with different types of cage bedding (wooden, cellulose, or corncob), or without bedding as well as feeding high-fibre diets.

Results: The antibiotics treatment diminished CR-specific increase in the levels of free taurine and its conjugates as well as upregulated expression and activity of GSH transferases (GST) in the intestinal mucosa. Further, it diminished a CR-related increase in BAs levels in the liver, plasma, and intestinal mucosa. Transplant of microbiota from CR mice to *ad libitum* fed mice triggered CR-like changes in GST expression, levels of taurine and taurine conjugates in the mucosa of the ileum. The type of cage bedding affected faecal microbiota composition, the levels of BAs and taurine as well as GST expression in the intestine mucosa. Complete removal of cage bedding resulted in decreased BAs deconjugation while feeding high-fibre diet impacted mostly the levels of free taurine.

Conclusions: CR animals supplement their diet with cage-bedding derived fibre. High-fiber consumption leads to breeding microbiota with high BAs-deconjugation capacity resulting in increased levels of free taurine and unconjugated BAs in the intestine of CR animals. Whereas, the trigger to increase synthesis and release BAs from the liver into the intestine is not microbiota-dependent but relies on CR.

Keywords: Caloric restriction, microbiota, Bile acids, Taurine, Glutathione

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T1)3-2
Transcription co-activator PGC-1α regulates gene expression in Neuromuscular junction

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Background and objectives: Neuromuscular junction (NMJ) is a synapse between motoneurons and skeletal muscles. It has been reported that morphology changes and decreased function of NMJ occur under aging and various neurodegenerative diseases. Maintaining functionality of NMJ is important to extend healthy life expectancy. Expression of PGC-1α increases by exercise and intake of soy isoflavones. PGC-1α is known to activate mitochondrial biogenesis and energy consumption. To find new target genes for PGC-1α, we have performed microarray analysis using skeletal muscle derived from muscle specific PGC-1α knocked out mouse. As a result, Dok-7 was found, which is expressed at the NMJ on the skeletal muscle side and involved in NMJ formation. Dok-7 is important to form NMJ since deficiency of Dok-7 causes structural defects of NMJ. In this study, we examined whether PGC-1α regulates gene expression of Dok-7.

Methods: We performed gene overexpression or knockdown experiments of PGC-1α, using muscle satellite cells, transfected with either retrovirus or siRNA. Gene expression of Dok-7 and other NMJ related genes were then examined. PGC-1α is known to increase expression of target genes by co-activating nuclear receptors such as ERR. Therefore, we investigated whether ERR binding element exists in 2000 bp upstream of the Dok-7 promoter. Then, we created a plasmid in which 2000 bp upstream of the Dok-7 promoter was integrated upstream of luciferase gene. We used this plasmid with co-expressing PGC-1α and ERRαto examine luciferase activity of Dok-7 promoter.

Results: Gene expression of Dok-7 increased by overexpression of PGC1α, whereas gene expression of Dok-7 showed a decreasing trend by knockdown of PGC-1α. ERR binding elements were present in 2000 bp upstream of Dok-7 promoter. In addition, luciferase activity of Dok-7 promoter was greatly increased by co-expressing PGC-1α and ERRα.

Conclusions: This study showed that PGC-1α increased gene expression of Dok-7 and Dok-7 promoter was significantly increased by co-expressing PGC-1α and ERRα. These results may lead to preventing morphology changes and decreased function of NMJ under aging and neurodegenerative diseases.

Keywords: PGC-1α, Dok-7, ERR, Neuromuscular junction, Skeletal muscles

OAB(T1)3-3
Loss of FOXOs in skeletal muscle prevents the onset of cancer cachexia-induced muscle atrophy

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Background and objectives: Cancer cachexia is a multifactorial disease characterized by systemic inflammation, body weight loss, and loss of muscle mass. Evidence has demonstrated that muscle atrophy in cancer cachexia leads to anorexia, frailty, and shortened lifespan. In advanced cancer, approximately 80% of cancer patients develop cancer cachexia, which accounts for up to 20% of cancer death. We previously identified novel FOXO1 target genes in skeletal muscle using skeletal muscle-specific FOXO1 transgenic and starved FOXO1/3a/4 knockout mice (FOXO1,3a,$4^{-/-}$ mice) (Oyabu et al. 2022. ***FASEB J***. In this study, we developed cancer cachexia model of FOXO1,3a,$4^{-/-}$ mice to investigate the role of FOXOs in cancer cachexia-induced muscle atrophy. The objective of this study was to reveal whether loss of FOXO could prevent cancer cachexia-induced muscle atrophy and identify novel FOXOs target genes in cancer cachexia.

Methods: Tumor-bearing FOXO1,3a,$4^{-/-}$ mice were generated by subcutaneous implantation of 6×10^6 Lewis lung carcinoma (LLC) cells dissolved in 100 µL PBS into the right flank of FOXO1,3a,$4^{-/-}$ mice. To create in vitro cancer cachexia model, we co-cultured C2C12 myotubes and LLC cells using cell culture inserts, or LLC-conditioned medium (LLC-CM) was added to C2C12 myotubes.

Results: Cancer cachexia induced muscle atrophy in tumor-bearing WT (wild type) mice, while muscle atrophy was markedly suppressed in FOXO1,3a,$4^{-/-}$mice. As the results of qRT-PCR, FOXO1, FOXO3a, and FOXOs target genes (*Atrogin1*, *MuRF1* etc.) were significantly upregulated in the tumor-bearing WT muscle, but not in FOXO1,3a,$4^{-/-}$ muscle. In addition, several novel FOXOs target genes were identified. Co-culture of C2C12 myotubes with cancer cachexia-inducible LLC cells, or addition of LLC-CM to C2C12 myotubes caused marked myotube atrophy with significant increase of authentic- and novel-FOXOs target genes.

Conclusions: In this study, we found that cancer cachexia-induced muscle atrophy was prevented in FOXO1,3a,$4^{-/-}$ mice and identified novel FOXOs target genes using cancer cachexia model of FOXO1,3a,$4^{-/-}$ mice. Moreover, LLC cells caused marked activation of FOXOs signaling in C2C12 myotubes without other types of cells and direct cell–cell contact. The data obtained from this study further sheds light on FOXOs or their up/downstream factors as potential therapeutic targets of cancer cachexia.

Keywords: Muscle atrophy, FOXO, Cancer cachexia, Anorexia, Disease

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T1)3-4
Obesogenic diet consumption impairs mitochondrial function of epithelial cells in mouse jejunum

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Background and objectives: Obesity and overweight are associated with low-grade inflammation linked to alterations of intestinal barrier and microbiota. Intestinal homeostasis is supported by mitochondrial function of intestinal epithelial cells (IEC), as it provides the energy needed for nutrient absorption, epithelial renewal, and maintaining of intestinal barrier. However, western diet (WD) consumption, characterized by high fat and sugar levels, may impair mitochondrial function as observed in hepatic cells. The aim of this study was to assess whether WD consumption alters mitochondrial function of IEC in mouse jejunum.

Methods: Male C57Bl/6J mice were fed a control diet (CTRL, fat = 10% of energy) or a WD (WD, fat = 58% of energy and drink water supplemented with fructose and sucrose (42 g/L)). After 22 weeks, jejunal IEC were isolated to assess mitochondrial function by Seahorse® technology and gene and protein expressions.

Results: WD mice were obese and characterized by increased visceral adiposity index (2.2±0.3 vs 6.7±0.4 %, P<0.0001) and endotoxemia (LPS-BP: 535.8±38.5 vs 668.7±39.7 ng/mL, P<0.05) compared to CTRL mice. Mitochondrial function analysis of IEC from WD mice revealed a two-fold decrease in basal respiration (60.6±8.9 vs 33.3±6.0 pmol O_2/min/DNA, P<0.05) and significant decrease in gene and protein expressions of subunits from electron transport chain complexes. Moreover, *Pgc1-α*, the main regulator of mitochondrial biogenesis, was 60% less expressed in IEC of WD mice compared to CTRL (P<0.001) while the expression of genes involved in mitochondrial fusion and fission (*Mfn2, Opa1, Fis1* and *Pink1*) was reduced by 10 to 50%. Finally enumerated mitochondria analyzed by electron microscopy, were two-fold less numerous in WD mouse IEC (51±15 vs 25±16, P<0.0001).

Conclusions: In conclusion, in mice, WD consumption induced an alteration of the mitochondrial dynamics associated with a decrease in the number of mitochondria per enterocyte and in the expression of electron transport chain subunits, which in turn caused an important reduction of basal IEC respiration. Those metabolic mitochondrial alterations may be linked to the alterations of intestinal homeostasis and to low-grade systemic inflammation observed in obesity.

Keywords: Obesity, Intestine, Mitochondria, Metabolism

OAB(T1)3-5
Effect of lard-, olive oil- and soybean oil-enriched diet on immunoglobulin A coating of gut bacteria

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Background and objectives: Immunoglobulin A (IgA) is a major gut antibody and partly contributes to symbiosis with gut bacteria by selective coating. We recently showed that lard-enriched diet (60%/kcal) feeding reduces the amount of IgA coating fecal bacteria. However, it remains elucidated whether a diet enriched with dietary oils such as olive oil and soybean oil influences on IgA coating of gut bacteria. In this study, we compared the effect of lard-, olive oil- and soybean oil-enriched diet feeding on IgA reactivity to gut bacteria.

Methods: Mice were divided into four groups and fed a control diet (Control group) or a high-fat diet containing lard (HL group), olive oil (HO group), or soybean oil (HS group) at 45%/kcal. At week 27, the feces were collected and suspended with PBS. The supernatant and fecal bacterial pellet were separated by centrifugation. The fecal bacterial pellet was used to detect (a) the total amount of IgA coating bacteria (μg/g feces) by immunoblotting. (b) The total amount of IgA in the fecal supernatant (μg/g feces) was measured by ELISA. The ratio of (a) to (b) was calculated to predict how much amount of IgA was specific for gut bacteria.

Results: There was no significant difference in the total amount of IgA coating bacteria among groups. Inconsistent with the previous study, lard-enriched diet-induced reduction of the total amount of IgA coating bacteria wasn't observed possibly due to the reduced lard content in the diet from 60%/kcal to 45%/kcal. The total amount of IgA in the fecal supernatant was significantly higher in HL group than in other groups while there was no significant difference among Control, HO, and HS group. The ratio of (a) to (b) was significantly reduced in HL group as compared to Control group, but not in HO and HS group.

Conclusion: Our findings suggest that a lard-enriched diet (45%/kcal) intake may increase total IgA secretion while the ratio of bacteria-specific IgA in total IgA may conversely decrease. Meanwhile, olive oil- and soybean oil-enriched diet intake may not influence the amount of total IgA and bacteria-specific IgA secretion.

Keywords: Fat and oil, Immunoglobulin A, Gut bacteria

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T1)3-6
Potential roles of polyamines on DNA methylation in fetal period

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Background and Objective: Our previous studies have indicated that maternal protein malnutrition in SHRSP rat during pregnancy increases salt sensitivity and changes DNA methylation profile in the renal tissue in offspring. However, the underlying mechanism is still unclear. Polyamine have a variety of physiological roles in the regulation of growth, development and health, and its metabolism utilized decarboxylated S-adenosylmethionine which affect DNA methyltransferase activity. The present study performed *in vivo* and *in vitro* experiments to tested our hypothesis that maternal protein malnutrition decreases polyamine concentration in fetal tissues and polyamines are an important mediator of DNA methylation.

Methods: Nine week-old pregnant WKY/Izm rats were fed 20% (CN) or 9 % (LP) casein diet, and collect kidney, liver and heart samples from maternal and fetal rat at embryo 20 days. HepG2 and HEK293 cells were treated with difluoromethylornithine (DFMO), which is an inhibitor of ornithine decarboxylase (polyamine synthesis enzyme), and 500μM putrescine (Put), 10 μM spermidine (Spd), or 10 μM spermine (Spn). Polyamine concentration in fetal tissues and global DNA methylation ratio in cells were determined by ultra-high performance liquid chromatography (Shimadzu).

Results: In WKY rat, the polyamine concentrations of maternal tissues were not changed by LP diet. Notably, Spd concentration in fetal hepatic and renal tissues was significantly decreased by LP diet compared to CN group. No significant changes were observed in the concentrations of heart polyamine, and Put and Spd in liver and kidney of fetus. In HepG2 cells, DFMO treatment significantly increased the global DNA methylation ratio, and this increase was significantly suppressed by Spd supplementation. Similar trend was observed in HEK293 cells.

Conclusion: This study indicated that maternal protein malnutrition decreased the concentrations of Spd in fetal kidney and liver, and the concentrations of intracellular polyamine, in especially Spd have an important role in mediating cellular DNA methylation. Thus, polyamine could be an important mediator of DNA methylation profile in fetal period. The further investigation such as methylome analysis is required to indicate this possibility.

Keywords: Polyamine, Spermidine, DNA methylation, low protein, epigenetics

Conflict of Interest Disclosure: HK is a member of the Social Cooperation Program funded by Ajinomoto Co.

OAB(T1)3-7

Transport of vitamin K by ABC transporters

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Background and objectives: ABCG5 and ABCG8 are half-type ABC transporters and function as heterodimers on the apical membrane of intestinal epithelial cells and hepatocytes. The ABCG5/ABCG8 heterodimer limits cholesterol absorption in the intestine and increases cholesterol excretion in the liver by transporting cholesterol to bile. NPC1L1, a cholesterol importer, and ABCG5/ABCG8 cooperatively regulate cholesterol absorption and excretion. ABCG5/ABCG8 transports not only cholesterol but also plant sterols, such as sitosterol. Mutations in ABCG5 or ABCG8 genes cause a genetic disease, sitosterolaemia, characterized by high serum levels of cholesterol and plant sterols, leading to premature atherosclerosis. ABCG5/ABCG8 functions in the export of cholesterol from cells and NPC1L1 functions in the import of cholesterol. NPC1L1 has been reported to transport not only cholesterol but also vitamin K. The objective of this study is to examine if ABCG5/ABCG8 transports vitamin K like NPC1L1.

Methods: BHK and HEK293 cells expressing ABCG5/ABCG8 were incubated with vitamin K1 or vitamin K3. Cytotoxicity of vitamin K3 was analyzed by MTT assay and transport of vitamin K1 was analyzed by HPLC assay.

Results: Because high concentrations of vitamin K3 show cytotoxicity, cytoprotective effects of ABCG5/ABCG8 were examined. BHK or HEK293 cells expressing ABCG5/ABCG8 were more resistant to cytotoxicity of vitamin K3 than control cells, suggesting that ABCG5/ABCG8 transports vitamin K3 out of the cells. Addition of vitamin K1 reversed the effect of ABCG5/ABCG8, suggesting that vitamin K1 competitively inhibited the transport of vitamin K3. To examine the transport of vitamin K1 by ABCG5/ABCG8, vitamin K1 levels in the medium and cells were measured by HPLC analysis. Vitamin K1 level in cells expressing ABCG5/ABCG8 was lower than that in control cells, and vitamin K1 efflux from the cells to medium was higher in cells expressing ABCG5/ABCG8.

Conclusions: ABCG5 and ABCG8 are involved in the transport of not only sterols but also vitamin K. ABCG5/ABCG8 and NPC1L1 may play important roles in regulation of vitamin K absorption.

Keywords: ABC transporter, vitamin K, cholesterol, absorption

OAB(T1)3-8

Functional relationship between phosphatidylcholine profiles and skeletal muscle function—Metabolic analyses of skeletal muscle-specific GDE5 deficient mouse

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Background and objectives: Choline plays important roles in cell functions mainly as a precursor for phosphatidylcholine (PC), a predominant phospholipid in mammalian membranes. Glycerophosphodiesterase5 (GDE5) is a novel enzyme which can hydrolyze glycerophosphocholine (GPC) into choline *in vitro*, suggesting its potential role in PC metabolism and turnover *in vivo*. Previous studies strongly suggest that choline metabolism is tightly involved in muscle functions through alteration of membrane phospholipid composition. However, the mechanism on how PC composition is endogenously regulated and its physiological significance in skeletal muscle functions remain unclear. Thus, we aimed to investigate GDE5 roles in choline/PC metabolism and biological importance of PC composition in skeletal muscles.

Methods: Skeletal muscle-specific GDE5 knockout (KO) mice were generated using genome editing technique and Cre/LoxP system, and subjected to lipidomic and metabolomic analyses to examine the metabolic changes due to GDE5 deficiency. Furthermore, we tested fatigability and contractile force of GDE5 KO mice using *in situ* model of muscle fatigue to provide new perspectives on the biological significance of GDE5 in muscle functions. Finally, we employed muscle atrophy models, namely denervation and Duchenne muscular dystrophy, and docosahexaenoic acid (DHA)-rich diet, to further investigate physiological roles of GDE5 and PC composition in muscle functions.

Results: GDE5 deficiency in skeletal muscles, intriguingly, led to not only GPC accumulation but also an alteration in PC composition with a decrease in DHA-rich PCs and an increase in linoleic acid-rich PCs, accompanied by increases in glycolysis-related metabolites and glycogen levels. Interestingly, GDE5 KO showed a significant decrease in muscle strength, possibly due to larger Ca^{2+} leaks from sarcoplasmic reticulum. Both atrophy models showed decreased GDE5 expression and similar PC composition to that of GDE5 KO. DHA-rich diet, by which PC composition was inversely attenuated, resulted in higher contractile force compared to corn-rich diet. Furthermore, GDE5 KO mice exhibited higher fatigue resistance than wild-type mice, likely due to elevated glycogen level in skeletal muscle.

Conclusions: This study provided evidence on GDE5 roles as a key enzyme for regulation of PC composition. Importantly, our study also provides new insights on the potential association between PC composition and skeletal muscle contraction.

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Keywords: GDE5, phosphatidylcholine, glycerophosphocholine, membrane phospholipid composition, skeletal muscle function

OAB(T1)4-1

Salt intake reduction using umami substance-incorporated food in Japan and the United States

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Background and objectives: Excessive salt intake is linked to the development of several chronic diseases. Reducing the sodium content of foods is a globally important public health activity to achieve salt reduction and health promotion. We estimated the effect of sodium substitution with umami substances on the daily salt intake reduction among adults in Japan and the United States. The umami substances considered were glutamate, inosinate, and guanilate.

Methods: For Japan, 21805 participants aged 20 years and older from the 2016 National Health and Nutrition Survey (NHNS) were included. A multivariable linear regression approach was employed to estimate the contributions of each food item to daily salt intake, using total salt intake (g/day) as a dependent variable and intake (g/day) from food items and other covariates as independent variables. Possible salt reduction rates for each food item without compromising the taste due to substitution with umami substances were estimated based on an extensive literature review. Then, we estimated the population-level salt reduction based on the contribution of each food to salt intake estimated by the regression model.

A similar approach was applied to the analysis of the United States, which included 4139 participants aged 20 years and older from the 2017-2018 National Health and Nutrition Examination Survey (NHANES).

Results: The average salt intake was 9.95g/day (standard deviation 3.2) and 8.35g/day (3.8), respectively. The salt intake of adults in Japan can be reduced by 12.0-21.1% at the population level by substituting umami substances, which corresponds to 1.27-2.22g of salt reduction. For adults in the United States, salt intake could be reduced by 5.51-10.54% at the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

population level, corresponding to 0.46-0.88g of salt reduction. About 60% of Japanese adults could meet the national dietary goal of 8g/day, while 7.6% could achieve the World Health Organization (WHO)'s recommendation of 5g/day. About 23.73% of adults in the United States could achieve the WHO's recommendation.

Conclusions: Excessive salt intake is a global public health challenge, and reducing the intake is one of the most cost-effective measures to improve population health. We provide essential information on the potential salt reduction from sodium replacement with alternatives.

Conflict of Interest Disclosure: K.S. report a grant from the Ajinomoto Co., Inc. H.U. declares that he is employed by Ajinomoto Co., Inc. and has no other competing interests. All other authors declare no competing interests.

Keywords: sodium, salt, umami, Japan, United States

OAB(T1)4-2
Precision Nutrition: Concepts and perspectives of future nutrition

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Background and objectives: After individual characteristics could be determined through genomic analysis, comprehensive multi-omics analysis methods were developed. Furthermore, the development of information technology and artificial intelligence has enabled precise individualization. This type of personalized nutrition is called “Precision Nutrition”. Recently many attempts have been made to individualize by using physical information obtained from wearable devices and other sources. The body clock is not only important for health, but it is also a "constitution" that continues to turn for a certain period of time once it starts turning. Controlling the body clock from a chrono-nutrition perspective is an important strategy in precision nutrition.

Methods and Results: We individualized personal data that is relatively easy to obtain, such as gender, age, physical measurements, and health examination results. This typification allows us to determine the nutrients required for each individual and to calculate a personalized dietary intake. The "N-type Personal Dietary Reference Intakes" was developed as a web tool so that anyone can easily calculate it. We are then constructing a system that proposes healthy diet menus based on the Personal Dietary Reference Intake. We are currently building an individual dish database. The biological clock is one of the "constitution" of the body. “Rhythmome”, which considers totality of biological rhythms on a time axis from seconds to years, can be used in personalized nutrition. To measure the body clock in humans, blood samples are needed to be taken every few hours to examine the rhythm of expression of clock genes. As a non-invasive method, we created a smartphone application ("Chrono-Nutrition Clock") that infers the body's metabolic rhythms by simply recording the timing of meals. By tapping the screen to record the timing of meals, bowel movements, and entering body weight, the application calculates the body clock (metabolic rhythm), bowel clock, and sleep clock. By using this, the approximate body clock can be visualized. In other words, you can see that this is your current "constitution”.

Conclusions: We are now developing the future nutrition “Precision Nutrition” platforms. Some of them have been completed to make a prototype model.

Keywords: Precision nutrition, Personalized nutrition, Rhythmome, Chrononutrition, Precision medicine

Conflict of Interest Disclosure: No

Further Collaborators: No

OAB(T1)4-3
Application of a machine learning approach to predict the added sugar content of foods and beverages in the food supply

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Background and objectives*:* Dietary guidelines recommend limiting the intake of added/free sugars. However, information about added/free sugar content is not provided on food labels in most countries, making it difficult for consumers to avoid products with added-sugar, and limiting the ability of policymakers to identify priority products for intervention. The objective was to apply a machine learning approach to calculate added sugar content in packaged foods and beverages.

Method*:* The added-sugar prediction algorithm was developed using k-nearest neighbors (KNN) and packaged food information from the University of Toronto Food Label Information Program (FLIP) 2017 (n=17,448) and 2020 (n=74,445). Selected food categories (Bakery, beverages, cereals/grains, dairy, desserts, fruits and fruit juices, snacks and sugars/sweets) with added-sugar information calculated from a series of manual steps from FLIP2017 were trained and tested to predict added-sugar content of foods in the same food categories in FLIP2020. Performance metrics included the coefficient of determination (R^2) and mean absolute error (MAE).

Results*:* Predicted and true added-sugar values (mean±sd) from FLIP2017 data were similar for all food categories: Bakery; 15.2±13.6 vs. 15.1±14.4, beverages; 9.8±18.5 vs. 9.4±17.9, cereals/grains; 4.6±8.7 vs. 4.5±8.9, dairy; 3.3±7.0 vs. 3.3±7.4, desserts; 25.1±19.9 vs. 24.3±20.2, fruits/juice; 11.0± 13.9 vs. 11.0±14.5, snacks; 4.7±9.1 vs. 5.1±10.5, sugars/sweets; 47.1±23.1 vs. 46.3±23.9). Predicted added sugar content for FLIP2020 was similar to the true value for FLIP2017 for following (bakery; 14.9±11.6, beverages; 10.6±7.5, cereals/grains;

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

4.01±8.28, desserts; 19.7±15.4, fruits/juices; 13.1±9.1, sugars/sweets; 42.3 ± 20.3, except for dairy (1.8±5.5) and snacks (3.3±7.4). KNN was apt at explaining variance in added-sugar content (R^2 ranging from 0.80 to 0.95) and achieved prediction accuracies with small MAE for all selected categories (range: 0.9g/100g (cereals/grains) to 3.78g/100g (sugars/sweets)).

Conclusions*:* Our findings show that the KNN approach can be used to predict the added-sugar content in packaged products with a high degree of validity, using total sugars and ingredient lists on foods. Being automated, KNN can be applied to large datasets, reducing the reliance on manual calculations. In the absence of mandated added-sugar labelling on products, KNN can be used to monitor the added sugar levels in food supply, informing of potential policy actions to reduce added-sugar intakes.

Keywords: added sugar, automated, machine learning, packaged food supply, prediction

Conflict of Interest Disclosure: No Conflicts of Interest to declare.

OAB(T1)4-4
Social jetlag is associated with gut microbial composition in the ZOE PREDICT cohort

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Background and objectives: Social jetlag (SJ), the term for an earlier sleep midpoint during working days compared to free days (usually weekends), is a prevalent form of chrono-disruption. Inconsistent sleep timing is associated with poor diet quality and less favourable cardiometabolic outcomes. Gut dysbiosis may partially mediate the effects of social jetlag on cardiometabolic risk factors. We explored associations between SJ and the gut microbiome in the densely phenotyped PREDICT 1 cohort.

Methods: Participants reporting habitual sleep (males, n=258, females, n=673, 18-65y) were identified from the ZOE PREDICT 1 study, a multi-centre study of 1001 healthy UK individuals (NCT03479866). Demographic information, habitual diet (FFQ), cardiometabolic blood biomarkers, and stool metagenomics were collected. SJ was calculated as a difference of >1.4h in weekday sleep midpoint versus weekend sleep midpoint. Differences in pre-specified microbial species (those previously shown to be associated with more and less healthy plant-based foods) were tested by linear regression analysis following arcsine transformation (adjusted for diet quality and multiple comparison (FDR)).

Results: The SJ group (16% of cohort, n=145) had a higher proportion of males than the non-SJ group (39% *vs* 25%) and were younger (mean±SD) (38.4±11.3y *vs* 46.8±11.7y). Only 5% of the SJ group reported inadequate sleep duration over 7 days (average <7 h/night), similar to non-SJ (3%). SJ was associated with a lower healthful plant-based dietary index (P<0.05). Following adjustment for diet quality, SJ was associated with lower relative abundances of "good bacteria" Firmicutes bacterium CAG:95, Oscillibacter 57_20, Oscillibacter PC13, Eubacterium eligens, and higher for "bad bacteria" Ruminococcus gnavus, Clostridium symbiosum, Clostridium bolteae, and Flavonifracter plautii (all q<0.05), and higher fasting concentrations of glycoprotein acetylation (GlycA), a marker of systemic inflammation (P<0.05), adjusted for sex, age, BMI, ethnicity and socio-economic status.

Conclusions: In a predominantly female cohort with adequate sleep duration, SJ is associated with a less favourable gut microbiome composition, and higher inflammation, with implications for the role of modest circadian misalignments on inflammatory processes that underpin chronic non-communicable diseases.

Keywords: Social jetlag, Microbiome

Funding: ZOE Ltd

Conflict of Interest Disclosure: TDS, JW and GH are co-founders of ZOE Ltd (ZOE). TDS and SEB are consultants to ZOE. Other authors have no conflict of interest to declare.

OAB(T1)4-5
The effect of Bacillus clausii UBBC07 supplementation on the absorption of essential amino acids from whey protein

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Background and objectives: Gut microbiota composition optimization, through supplementation of strains specific probiotics have been linked to improved essential nutrient absorption and its utilization. Essential amino acids have to be supplied from an exogenous diet because the human body lacks the metabolic pathways required to synthesize these amino acids. This study evaluated the effect of probiotic *Bacillus clausii* UBBC07 supplementation on protein absorption, assessed through circulating plasma free essential amino acids. **Methods**: In this double-blind, placebo-controlled, randomized study, seventy physically active male participants (21.5 ± 3.2 yrs) were enrolled to receive either a probiotic consisting of 2 x 10^9 CFU *Bacillus clausii* UBBC07 along with 20gm whey protein (n=35) or a placebo consisting of 20gm whey protein only (n=35) for 60 days. Plasma amino acids levels were determined at baseline, 30 days, and 60 days using HPLC-FLD. The effect of probiotics was assessed on total essential amino acids (EAAs), total branched-chain amino acids (BCAAs), and total plasma amino acids (TPAAs) via repeated-measures analysis of variance. **Results**: Data from our study indicate that plasma EAAs levels (215.37 pmol/µl, 95%CI: 117.8-312.9, vs 42.6 pmol/µl, 95%CI:-10.8-96.1, p=0.002) and TPAAs levels (859.10 pmol/µl, 95%CI:455.4-1262.8 vs 87.9

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

pmol/µl, 95%CI:-202.0-377.9; p=0.002) were significantly improved in the probiotic group as compared to the placebo group. The total BCAA levels were significantly improved by 23.4% (p=0.005) in the probiotic group as compared to the placebo group. When BCAAs were analyzed individually, significant improvement was revealed in isoleucine by 26 % (p=0.017), leucine by 32.9% (p=0.001), and valine by 19.7% (p=0.029). In repeated-measures analysis of variance, a significant group × time interaction was revealed for EAAs (p=0.015), TPAAs (p=0.004), and BCAAs (p=0.028) as well as isoleucine (p=0.041), leucine (p=0.028) and valine (p=0.042). **Conclusions**: In this study, a significant effect of *Bacillus clausii* UBBC07 supplementation was observed on essential amino acids absorption which would be helpful for vital processes such as building proteins, hormones, neurotransmitters, muscles growth, and nitrogen balance.

Keywords: Probiotics, Amino acids, Absoption

Conflict of Interest Disclosure: The authors declare that there was no conflict of interest. JN and RSM are employed by Unique Biotech Ltd. which is a manufacturer of probiotics. They wish to state that the study was conducted independently with no intervention on their part during the duration of the study.

Further Collaborators: N/A

OAB(T1)4-6
Novel microbiome links with diet and cardiometabolic health via previously uncharacterized species from the ZOE PREDICT 1 study

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Unhealthy diet and lifestyle, physical inactivity, and smoking are associated with cardiometabolic diseases, and the human gut microbiome is increasingly regarded as one key mediator. The ZOE PREDICT 1 study highlighted that the gut microbiome was predictive for markers of cardiometabolic status and associated with dietary patterns (Asnicar et al. 2021). However, current metagenomic profiling relies on well-characterized microbial genomes that do not cover the fraction of commensal species not yet described through cultivation.

Large-scale metagenomic assembly efforts generated metagenome-assembled genomes (MAGs), including uncharacterized species. We clustered the largest set of MAGs and well-characterized genomes into species-level genome bins (SGB). Markers defined on each SGB were then exploited for improving taxonomic profiling. The ZOE PREDICT 1 cohort was re-profiled and machine learning and association analyses performed on the SGBs present in at least 20% of the samples with the previously identified 19 dietary and cardiometabolic markers.

We identified a new microbial signature of cardiometabolic health and found a novel set of SGBs more strongly associated with the previously assessed dietary and cardiometabolic indices. Overall, the SGB profiles showed stronger associations for 17 out of the 19 markers. Most of the SGBs positively associated with favourable markers were uncharacterized species (9 out of 15), suggesting the important role the hidden fraction of the gut microbiome can have on the overall microbiome functions. Among the cultivated species, five have provisional and unofficial species labels (e.g., *Lachnospiraceae bacterium* NSJ-46 and *Lachnospiraceae bacterium*), while only *Haemophilus parainfluenzae* (SGB ID 9712) was present in the previous signature (Asnicar et al. 2021). The top associations with unfavourable diet and cardiometabolic indices were mainly from well-characterized species and only five were in common with the previous signature.

Findings suggest that the new approach integrating genomic information of uncultured species enables deeper investigations of microbiome samples. Importantly, deeper profiling resulted in stronger links between the microbiome and indices of dietary intake and cardiometabolic health. Considering that the human gut microbiome is a modifiable target through diet and supplementation, these advances may contribute to future precision nutrition approaches to lower the burden of cardiometabolic diseases.

Conflict of Interest Disclosure: TDS and JW are co-founders of ZOE Ltd (ZOE). SEB, FA, and NS are consultants to ZOE Ltd. RD is employed by ZOE Ltd. The other authors declare no competing interests.

Keywords: Human gut microbiome, Habitual diet, Cardiometabolic health, Machine learning, Uncharacterized microbial species

OAB(T1)4-7
Supermarket Transaction Records In Dietary Evaluation – the STRIDE study: validation against self-reported dietary intake.

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Background and objectives: Harnessing new technologies is recommended to deliver scalable objective methods for population dietary assessment. Supermarket transaction data offers great potential to explore small-area dietary patterns and has many advantages over survey methods. However, this data is rarely validated. The STRIDE (Supermarket Transaction Records In Dietary Evaluation) validation study compares dietary estimates from supermarket transactions with self-reported intake from an online Food Frequency Questionnaire (FFQ).

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: Working with a large UK supermarket retailer, loyalty card customers were recruited to one of four waves (accounting for seasonal dietary variation). Participants consented to sharing their transaction records for one year during the study, and one year prior. They additionally completed an online FFQ. The Bland-Altman method was used to calculate the agreement and limits of agreement between transactions and intake for daily energy, sugar, total fat, saturated fat, protein and sodium (absolute and energy-adjusted). Household composition is accounted for in individual purchase estimates.

Results: 1,788 participants from four UK regions consented to the study. 686 participants who completed the FFQ and made purchases during the same period, were included for analysis. Participants were mostly female (72%), with a mean age of 56 years (SD 13). Agreement varied by magnitude and thus a regression equation is presented for estimating intake from purchases. Agreement for absolute measures was poor overall, but was higher for single-person households and households who reported a higher proportion of their total food purchases coming from the retailer. Agreement was stronger for energy-adjusted nutrient estimates, particularly for fat. On average purchase records under-estimated the proportion of total energy intake from fat by just 2%.

Conclusions: The STRIDE study found household purchase records from a single retailer to be a poor proxy for individual-level absolute nutrient intakes. However, close agreement on average for energy-adjusted estimates suggests that purchases are a good indicator of dietary composition. This points to the utility of supermarket transaction records for population dietary assessment, ecological studies, and identifying intervention targets based on dietary patterns. Supermarket transaction data therefore have broad applicability for contributing to the design and monitoring of national and local-level policy interventions.

Conflict of Interest Disclosure: This work was supported by an in-kind data contribution and staff time (for tasks relating to study set-up and data extraction) from a UK supermarket retailer.

Keywords: Dietary assessment, Validation, Transactions, Methods, Population

OAB(T1)4-8

Diets enriched in sugar, refined or whole grains differentially influence serum cholesterol concentrations and cholesterol metabolism pathways with concurrent changes in gut microbiota composition in ApoE$^{-/-}$ mice

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Background and objectives: Previous studies have demonstrated differential effects of different types of carbohydrates on cholesterol concentrations in hypercholesterolemic individuals, yet little is known about the underlying mechanisms. Our aim was to compare the effects of diets enriched in sugar, refined or whole grains on serum cholesterol levels, cholesterol metabolism pathways and gut microbiota composition in ApoE$^{-/-}$ mice.

Methods: Forty-five male ApoE$^{-/-}$mice aged 8 week old were randomly fed an isocaloric high whole grain (HWG), high refined grain (HRG) or high sugar (HS) diet for 12 weeks. Diets were matched for similar macronutrient composition (55%E total carbohydrate, 20%E protein, 25%E fat), but differed in types of carbohydrates (accounted for 20%E from different types of carbohydrates). Fecal samples were collected from week 8 to 12 and fasting blood samples and liver and intestine tissues were collected following euthanization at week 12. Fasting cholesterol concentrations, gene expression involved in cholesterol absorption, synthesis, uptake, efflux and bile acid metabolism in liver and intestine, gut microbiota composition and fecal bile acid levels were measured using standard methods.

Results: Fasting serum total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) concentrations were higher in HRG and HS compared to HWG groups (P<0.001). The mRNA expression of hepatic IDOL was higher in the HRG than HWG group (P<0.05). The mRNA expression of intestinal LXR-α was lower in the HRG and HS than HWG group, and ABCG5 was lower in the HS than HWG group (P<0.05). HR resulted in higher amounts of fecal secondary bile acids than HWG group (P<0.05). The relative abundance of genus *Akkermansia*, *Alistipes*, *Alloprevotella*, *Bacteroides* and *Clostridia* were lower in HS than HWG group, and they were inversely associated with serum TC and LDL-C levels, fecal secondary bile acid levels and hepatic IDOL gene expression, and positively associated with intestinal LXR-α and ABCG5 gene expression (P<0.05).

Conclusions: Compared to HWG group, HRG and HS increased cholesterol levels via modulating gene expression that promoted cholesterol absorption and secondary bile acid synthesis and inhibited cholesterol uptake and efflux. Gut microbiota composition changed concurrently with these effects, and related to alterations in cholesterol level and metabolism.

Keywords: Sugar, Refined grain, Whole grain, Cholesterol metabolism, Gut microbiota

OAB(T2)1-1

Revealing the prevalence of "hidden hunger": global and regional estimates of micronutrient deficiencies among preschool-age children and non-pregnant women of reproductive age

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Background: Micronutrient deficiencies (MNDs) compromise immune systems, hinder child growth and development, and limit human capital worldwide. Yet the only existing estimate of the global prevalence of deficiency was from over three decades ago. It was based only on anemia, which is not necessarily attributable to a MND. We aimed to transparently estimate the global and regional prevalence of deficiencies in one or more micronutrients among preschool-age children (PSC) and non-pregnant women of reproductive age (NPW).

Methods: We reanalyzed and pooled individual-level micronutrient status biomarker data from 24 nationally representative, population-based surveys. We used Bayesian hierarchical logistic regression to estimate the prevalence of deficiency in one or more of three core micronutrients (iron, zinc, and vitamin A for PSC and iron, zinc, and folate for NPW) globally and in seven regions for the period 2005–2019.

Findings: We estimated the global prevalence of deficiency in at least one of three core micronutrients to be 56% (95% uncertainty interval 48 to 64) among PSC, and 69% (59 to 78) among NPW. This translates into a global total of 372 (319 to 425) million PSC and 1.2 (1.0 to 1.4) billion NPW with MNDs. Regionally, three quarters of PSC with MNDs live in South Asia (99 million, 80 to 118), Sub-Saharan Africa (98 million, 83 to 113), or East Asia and the Pacific (85 million, 61 to 110). Over half (57%) of NPW with MNDs live in East Asia and the Pacific (384 million, 279 to 470) or South Asia (307 million, 255 to 351).

Conclusion: There is a large burden of MNDs among women and children worldwide, especially in low- and middle-income countries.

Funding: The US Agency for International Development (USAID) provided financial support for this article through its flagship multisectoral nutrition project, USAID Advancing Nutrition.

Conflict of Interest Disclosure: All authors, no interests to disclose. The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Further Collaborators: Global Micronutrient Deficiencies research group

Keywords: micronutrient deficiencies, vitamins, minerals, children, women

OAB(T2)1-2

The Efficacy of Fish as an Early Complementary Food on the Growth of Infants aged 6 - 7 Months. A Randomised Controlled Trial.

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Background: Fish is a good animal source protein for growth and development. The main objective of the study was to assess the efficacy of fish during the early complementary feeding period on infants linear growth in Samfya district of the Luapula Province of Zambia in a 6 months randomised controlled trial.

Method: A randomized controlled trial was conducted from April 2019 to January 2020 in Samfya district, Luapula Province, Zambia. Eligible infants aged 6 - 7 months (n = 238) who attended the under-five clinic at the sampled Shikamushile Rural Health Centre were randomized to receive 12g fish powder (treatment) or 7g of sorghum powder (placebo) for six months. Participants were followed on a weekly basis to distribute the powder, record compliance/powder usage and any morbidities. Anthropometric measurements were taken monthly.

Results: Using STATA (version 16), a linear mixed-effects model was used to do an intention to treat analysis for the primary outcome (length-for-age). There was a significant intervention effect on the growth of infants ($p<0.005$) in the fish powder group compared to the sorghum powder group. Infants in the fish powder showed increased length-for-age z-scores by 1.26 (95% CI: 0.94 - 1.57: P = 0.0001), with most of the increase happening in the first three months.

Conclusion: Our results show that introducing fish early in the complementary feeding period improves the growth of infants. Therefore, fish can potentially be used as an early complementary food in low-income communities with access to fish.

Trial registration: clinicaltrials.gov Identifier: NCT03993860.
Conflict of Interest Disclosure: I have no conflict of interest.
Further Collaborators: none
Keywords: Fish, Complementary Feeding, Infants, Growth

OAB(T2)1-3

Body composition of children aged 9-14 years born low birth weight at term.

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Background and objective: India is facing an epidemic of obesity, that is unfortunately now encompassing children. A high burden of Low Birth Weight (LBW) coupled with an exposure to an obesogenic environment has added to the problem of undernutrition. The coexistence of undernutrition and overnutrition has been explained by Developmental Origin of Health and Disease (DOHaD) hypothesis. However, there is scant literature on the impact of being born full term LBW on physiological health outcomes in Indian children. The present study attempts to therefore fill this gap by assessing the body composition of children aged 9-14 years born LBW at term. **Methods**: A total of four hundred and four full term LBW children (gestation >37 weeks; birth weight:1.8-2.4 kg) from underprivileged areas of Delhi, NCR belonging to the Delhi Infant Vitamin D Supplementation cohort were traced and investigated. The studied parameters included anthropometry and body composition by bioimpedance analysis using Tanita MC-980MA. Standardized z-scores were calculated for anthropometric measures and data was analysed using STATA 16.

Results: The mean birth weight and age of LBW children studied was 2.2 (0.1) kg and 11.3 (0.9) years, respectively. During childhood, a substantial proportion of children had 'normal' BMI for age (67%) and height for age (81.4%) z-score. Data revealed higher percentage of children with MUAC-, skinfold thickness- and waist circumference z-score >1SD than children with z-score < -2 SD indicating adiposity. Sex specific analysis revealed similar results with no statistically significant difference among boys and girls. Body fat percent in these children was 13.9%, with a significantly higher percentage in girls than boys (17.3% vs 10.5%) ($p<0.05$).

Conclusion: Despite being born LBW, the pattern of body composition in term end LBW children is consistent with 'thrifty phenotype' resulting in the adiposity. The results indicate an ongoing change due to nutrition and epidemiological transition which strengthens the proposition that fetal programming affects body composition. Further continued research in these children in adulthood is required to substantiate the DOHaD hypothesis.

Conflict of Interest Disclosure: Authors declare no conflict of interest:

Further Collaborators: Not applicable

Keywords: low birth weight, full term, body composition, children, DOHaD

OAB(T2)1-4

Feeding practices among mothers and estimated nutrient intake of children during cooking demonstrations in Southern Benin

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Background & objectives: Cooking demonstrations (CDs) improve mother's knowledge on complementary foods, and may be convenient to estimate usual nutrient intake of their offspring. We assessed feeding practices of children aged 12-23 months and the nutrient content of meals consumed during monitored CDs. **Methods**: A total of 38 mother-child dyads were recruited under CARE International Benin's CI4N project. Mothers were invited for CDs at 10 sites constellated in Southern Benin. Children feeding practices were evaluated using a standardized questionnaire and compared to World Health Organization (WHO)'s recommendations. Direct observations and weighing were used to measure the ingredients, final recipes and meals consumed by each child. Energy intake and nutrients content of the meals were estimated using the FAO/INFOODS food composition table for West Africa. **Results:** About 53% of mothers followed WHO's best children feeding practices. Nutrient composition (per 100 Kcal) of the foods prepared at the CDs sites were: protein (6.4±3.8) g, vitamin C (8.2±6.8) mg, iron (2.2±2.1) mg, and zinc (0.9±0.6) mg. Assuming 3 or 4 meals per day, the energy density (kcal/g) of the foods was satisfactory for both breastfed (1.9±1.1 or 2.2±0.9) and non-breastfed (2.4±0 or 2.5±0.7). Meals consumed by the children provided on average 21.9%, 27.3%, and 37.9% of recommended daily intakes for vitamin C, iron, and zinc, respectively. **Conclusion**: More than half of mothers adopted best feeding practices. The meals consumed by the children were energy-dense, but low in essential micronutrients. Efforts towards supporting mothers through CDs to include indigenous micronutrient-dense or fortified foods should be strengthened.

Conflict of Interest Disclosure: NO

Keywords: Feeding practices, Infants, Cooking demonstration, Complementary food, Nutrients

OAB(T2)1-6

Iodine status and thyroid function in school aged children and pregnant women in Switzerland: Current situation and time trends

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Background: Voluntary salt iodization has been in place in Switzerland for 100 years and the current salt iodine concentration is 25 mg/kg. The iodine status is monitored at regular intervals in school-aged children (SAC) and pregnant women (PW) and the previous national study in 2015 indicated marginal iodine intake in pregnant women. The aim of this study was to monitor iodine status in SAC and PW in 2021/22 and investigate time trends.

Methods: In this cross-sectional national study conducted in 2021-2022 we aim to include 700 SAC and 500 PW. We measured urinary iodine (UIC) in spot urine samples. The current median UIC concentrations were compared with national data from 1999, 2004, 2009, and 2015. We measured thyroglobulin (Tg) in dried blood spots (DBS). Further data that will be available: salt iodine coverage, urinary creatinine concentrations (UCC), urinary sodium concentration in SAC, TSH and T4 in PW.

Results: Preliminary results showed a median (IQR) UIC of 111 µg/l (77, 159) in 167 SAC and 108 µg/l (53, 226) in 446 PW. Based on WHO cut-offs for median UIC, the iodine intake is classified as adequate in SAC, but mildly iodine deficient in PW. The UIC was lower compared to 2015 in both SAC (111 µg/l vs. 137 µg/l, *P*<0.001) and PW (108 µg/l vs. 140 µg/l, *P*<= 0.006). Women consuming iodine containing dietary supplements (54%) had higher UIC (168 µg/l) compared to those not consuming such supplements (89 µg/l, *P*<0.001). Median (IQR) Tg concentration in PW was 25.5 µg/l (17.3, 36.5) and 15.7% had elevated Tg concentration (>43.5 g/l). Median Tg concentration was significantly higher compared to 2015 (23.8 µg/l, *P*<= 0.005). Women consuming iodine containing supplements had lower Tg concentrations (21.5 µg/l) compared to those not containing such supplements (30.3 µg/l, *P*<0.001).

Conclusion: Our preliminary results indicate decreased iodine intake in SAC and PW since 2015. PW not consuming an iodine containing dietary supplement had insufficient iodine intake and elevated Tg. The longstanding salt iodization program in Switzerland must be further strengthened to ensure adequate iodine intake in all population groups.

Keywords: Iodine, Urinary iodine, Thyroglobulin, Salt iodization

OAB(T2)1-7

Validation of mobile AI-technology assisted dietary assessment in adolescent girls in Vietnam

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Background and objectives: There is a gap in the data on dietary nutrient intake of adolescents in low- and middle-income countries (LMICs). Traditional methods for dietary assessment are resource intensive and lack accuracy with regards to portion size estimation. Technology assisted dietary assessment tools have been proposed but constrained by lack of validity testing and feasibility of use in LMICs. We validated FRANI, a mobile Artificial Intelligence (AI) application for dietary assessment in adolescent girls aged 12-18y in Vietnam, against weighed records (WR) and compared performance of FRANI with a traditional 24-hour recall (24HR).

Methods: Dietary intake was assessed on 3 non-consecutive days in 36 adolescent girls using 3 methods: mobile FRANI app, WR and multi-pass 24HR. Equivalence of nutrient intakes was tested using mixed effect models adjusting for repeated measures, using 10%, 15% and 20% bounds. The concordance correlation coefficient (CCC) was used to assess the extent of agreement between methods. Sources of errors were identified for memory and portion size estimation bias.

Results: Equivalence between FRANI app and WR was determined at the 10% bound for energy, protein and fat and four nutrients (iron, riboflavin, vitamin B6 and zinc), and at 15% and 20% bounds for other nutrients except vitamin A and B12. Similar results were observed for relative differences between 24HR and WR with 20% equivalent bound for all nutrients except for vitamin A, B6 and B12. The CCCs between FRANI and WR (0.65-0.81) were slightly lower CCCs between 24HR and WR (0.71- 0.90) for energy and most nutrients. Memory error (food omissions or intrusions) was ~21%; no clear pattern on portion size estimation bias for foods. **Conclusions**: AI assisted dietary assessment and 24HR accurately estimate nutrient intake in adolescent girls. Errors could possibly be reduced with further improvements of AI-assisted food recognition and portion estimation.

Conflict of Interest Disclosure: No conflicts of interest.

Further Collaborators

Keywords: Adolescent, AI assisted dietary assessment, 24-hour recall, Validation, Vietnam

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T2)2-1
Assessing the diet quality of people living with HIV/AIDS in Ghana

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Introduction: Nutrition is a very important element of comprehensive care for people living with HIV/AIDS (PLHIV), especially in resource-constrained areas where malnutrition and food insecurity are common. Dietary diversity is a useful indication of nutritional adequacy (diet quality) in people of all ages. The study aimed to assess the nutritional status and diet quality of PLHIV using individual dietary diversity score as a proxy.

Methods: A facility-based cross-sectional study design was employed to select 440 people living with HIV from two hospitals in the Eastern Region of Ghana (Atua Government Hospital and St. Martins De Porres Hospital). Dietary intake was determined using 24-hour recall. A stadiometer and bioimpedance analysis machine were used to obtain anthropometric data. Diet quality was assessed using individual dietary diversity score as a proxy. Data were entered into MS Excel 2016 and transported into *SPSS* version 20 for analysis. Odds ratios and multiple logistic regression were used to identify factors associated with diet quality among the PLHIV. P-value was set at 0.05.

Results: Most of the PLHIV (73%) consumed from 'Starchy staple" food group. Less than 20 percent of the study sample had consumed 'Fruits' and 'Vegetables' (17% and 14% respectively). The mean IDDS was 4.11 (SD = 1.29). Overall, most of the people living with HIV (56%) had medium IDDS which is equivalent to "diet needing improvement', 14% had higher IDDS (good diet), whiles about 31% of the participants actually had poor diet (lower IDDS). Meal frequency (twice) per day (OR: 17.06, CI: 15.928-18.192, p<0.001), meal frequency (thrice) per day (OR: 16.96, CI: 15.892-18.019, p<0.001), First line type of ART (OR: 16.96, CI: 15.892-18.019, p<0.001), and 6-12 months duration on ART (OR: 16.96, CI: 15.892-18.019, p<0.001) were significantly associated with IDDS.

Conclusion: The dietary diversity scores indicated that most PLHIV need to improve their diet. Very few participants consumed a high-quality diet. The poor diet quality consumed by the participants could be attributed to the fact that starchy staples were the most consumed diet among respondents, whereas fruit and vegetable consumption was unsatisfactory.

Conflict of Interest Disclosure: There is no conflict of interest to be disclosed.

Further Collaborators: There are no further collaborators.

Keywords: diet quality, HIV, Ghana

OAB(T2)2-2
Evaluation of hemoglobin cutoff levels to define anemia among pregnant women: Biomarkers Reflecting Inflammation and Nutrition Determinants of Anemia (BRINDA) project

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Background/Objectives: Current WHO hemoglobin (Hb) cutoffs (<110 g/L) to define anemia during pregnancy are being revaluated as they are outdated and based on limited data lacking global representativeness. Prior WHO and BRINDA work has applied a statisitical approach to determine the cutoff for 95% of normal individuals. Our objective was to examine Hb cutoffs (defined as the 5th percentile of hemoglobin) overall and by trimester in a large multi-country dataset of iron replete pregnant women.

Methods: Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia (BRINDA) project provided 14 pregnancy datasets (n=14,077) from 12 countries. Iron replete was defined as: [ferritin>15 µg/L]. We examined the variability between datasets and association between hemoglobin and trimester, and estimated the 5th percentile of hemoglobin as anemia cutoff among iron-replete pregnant women, in pooled meta-analysis and by dataset and trimester.

Results: Our study only included women who were iron replete (n=10, 751). The intra-cluster correlation between datasets was 4.8%, indicating the vast majority of the variation in maternal Hb values during pregnancy was at the individual rather than the dataset level. Pooled Hb at the 5%ile overall during pregnancy was 96.8 g/L [91.4- 102.1] with high heterogeneity across datasets [range: 76 g/L (Niger) - 111 g/L (Mexico]. In five datasets with gestational age data and Hb values for each trimester (n = 5978), the pooled countries' Hb at the 5th %ile was 104.0 [100.0 - 108.1], 99.5 [93.5-105.4], and 98.4 [93.4-103.4] for the first, second and third trimesters, respectively.

Conclusions: Based on analysis from a large multi-country analysis, the majority of countries all had lower pregnancy Hb cutoffs compared to the currently used 110g/L. Only the US and Mexico had Hb cutoff values that were similar to WHO recommendations. Lower Hb cutoffs at the 2nd and 3rd trimester compared to the 1st trimester merits further examination. Further research on the functional consequences of Hb cutoffs with maternal and child outcomes and additional data on Hb by trimester are needed to validate potential revisions in hemoglobin cutoffs during pregnancy.

Conflict of Interest Disclosure: no conflicts of interest

Further Collaborators: BRINDA Pregnancy working group

Keywords: hemoglobin, pregnancy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T2)2-3
Micronutrient deficiencies are a critical public health problem in West Africa

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Background and Objectives: Micronutrient deficiencies negatively impact morbidity, mortality and child growth and development, thereby contributing to the vicious circle of poor nutrition and poor health and they restrain the development of societies. Recently, an international group of experts (Micronutrient Data Generation Initiative) has called for more data on the global extent of micronutrient deficiencies, to be able to inform policymakers on actions to be taken to improve health. Within the framework of the European Union Funded (2FAS) INSIDER project, we aimed to estimate the prevalence of micronutrient deficiencies in West-Africa.

Methods: We conducted a literature review of scientific papers published since 2009 on the prevalence of micronutrient deficiencies in West Africa (national or sub-national) as well as collected information from (sub-)national representative surveys (DHS, MICS, and micronutrient, iodine and SMART surveys) in order to map micronutrient deficiency prevalence. The analysis focused on children under 5 years of age (CU5) and women of reproductive age (WRA, 15-49 years of age). Prevalence data were used to classify countries according to their public health significance.

Results: Analysis showed that important data gaps existed on current micronutrient status of CU5 and WRA and on contributing factors to anemia and micronutrient deficiencies in West Africa. Only four countries (Sierra Leone, Ghana, Gambia and Côte d'Ivoire) have recent national data with only few micronutrients investigated in addition to anemia (essentially iron, folic acid and Vitamin A). Micronutrient deficiency and etiology differed widely between countries, but prevalence is high. Non-national data confirms these findings with deficiencies of iron, vitamin A and zinc being major public health problems in *CU5* in most countries while in WRA, deficiencies of iron, zinc and folate are most prevalent.

Conclusions: Most of West African countries should implement surveys on micronutrient status and etiology of deficiency to obtain reliable national representative data in order to inform policy makers and plan relevant actions. In addition, national micronutrient surveys have to be regularly conducted, to monitor micronutrient deficiency changes and to assess the impact of interventions addressing malnutrition and health.

Keywords: Micronutrient defiencies, West Africa, Women, Children

OAB(T2)2-4
The impact of MDCF-2 supplementation in improving linear growth among slum children with moderate acute malnutrition

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Background and objectives: Linear growth faltering or stunting, termed as a length-for-age-Z-score (LAZ) less than −2 SD from the median of the WHO Child Growth Standards, is the most common form of malnutrition with a deleterious effect on health during adulthood. An estimated 150 million children were reported to be stunted globally in 2020, of which more than one third lives in South Asia. In Bangladesh, the prevalence of stunting was 31% in 2017-18. Causes of stunting are multifaceted among which gut microbial dysbiosis has recently been emerged as an important one. Hence, novel microbiota targeted treatments to restore healthy child growth becomes a necessity. In that context a microbiota-directed complementary food formulation-2 (MDCF-2) was invented and was tested on malnourished children.

Methods: Between November 2018 and July 2020, a feeding trial was conducted among 123 moderate acute malnourished (MAM) children aged between 12-18 months living in an urban slum of Dhaka, Bangladesh. The children were randomly allocated into one of the two intervention arms MDCF-2 or ready-to-use supplementary food (RUSF) for 3 months. After the intervention period, these children were followed for a period of 24 months where anthropometric assessments were done at every 6 months to observe the long-term effects of the interventions on growth and development. We used linear-mixed effects models to compare the changes in linear growth between the two groups after controlling for differences in characteristics between the children at baseline.

Results: A total of 118 children completed the intervention. We observed sustained improvement in LAZ of the children who received MDCF-2 compared to the children who received RUSF. The mean (±SD) age of the children was 15.4±2.0 months. The difference in LAZ between the groups were statistically significant at 6 months (95% CI: 0.000, 0.004), 12 months (95% CI: 0.000, 0.003), 18 months (95% CI: 0.000, 0.003) and at 24 months (95% CI: 0.000, 0.003) of follow-up.

Conclusions: The study results imply the effective role of MDCF-2 in sustained improvement of linear growth of children enrolled in this trial.

Conflict of Interest Disclosure: The author declares no conflict of Interest.

Further Collaborators: None

Keywords: Microbiota directed complementary food, Malnutrition, Stunting

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T2)2-5

Development and validation of an online dietary assessment tool for use among different ethnic groups in Ireland

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Background and objectives: Diversity of ethnic groups living in host countries is rising globally. According to the latest census, the average growth rate of ethnic groups in Ireland is almost 20% annually. Despite this, health disparities between minorities and host populations are prevalent with ethnic minorities at higher risk of chronic disease and suffer from delayed diagnosis and treatment when compared to host populations. Causes are multifactorial and lifestyle and diet are known risk factors. However, there is a paucity of data which examines dietary intake of ethnic minorities, meaning it is difficult to ascertain where public health interventions are most required to illicit positive lifestyle change. Data harmonisation provides opportunity to better understand dietary intakes of multiple ethnic groups globally by utilising existing data. FNS Cloud will facilitate the accessibility and reuse of dietary data, allowing researchers to answer novel research questions.

Methods: To ensure Foodbook24 caters for diverse food and language options, participants were invited to complete a qualitative record of their diet and two 24-hour dietary recalls via Foodbook24 (Study I). To ensure Foodbook24 is an accurate measure of dietary intake, recalls via Foodbook24 were compared to traditional interviewer-led 24-hour recalls (Study II).

Results: To date n=62 Irish and n=30 Brazilian participants have completed this research. The Foodbook24 food list was deemed extensive, containing over 80% of foods reported by all participants. When compared to interviewer-led 24-hour recalls, minimal significant differences in nutrient and food group intakes were noted for both cohorts suggesting that Foodbook24 is an accurate measure of dietary intake of Irish and Brazilian groups in Ireland.

Conclusions: Preliminary results from Study I and Study II suggests that Foodbook24 accurately measures dietary intake of Irish and Brazilian adults in Ireland. Future analysis will be completed on Irish, Brazilian and Polish groups to ascertain the appropriateness of Foodbook24 in assessing dietary intakes of multiple ethnic groups living in Ireland.

This work was undertaken by University College Dublin a beneficiary in FNS-Cloud (www.fns cloud.eu), which has received funding from the European Union's Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3. – A sustainable and competitive agri-food industry) under Grant Agreement No. 863059.

Keywords: Ethnicities, Dietary assessment, Dietary intake

OAB(T2)3-1

Examining the diet quality of Canadians and the alignment of the proposed Canadian 'high-in' front-of-pack labelling regulations with other front-of-pack labelling systems and dietary guidelines

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Background and objectives: Canada proposed mandatory front-of-pack labelling (FOPL) regulations, where pre-packaged foods meeting or exceeding recommended thresholds for nutrients-of-concern must display 'high-in' symbols. However, there is limited evidence on how the proposed Canadian FOPL regulations (CAN-FOPL) compare to other FOPL systems and dietary guidelines, particularly those for non-communicable diseases. The objectives were to examine the diet quality of Canadians and the alignment of CAN-FOPL against other FOPL systems and dietary guidelines.

Methods: A single-day dietary recall from the nationally representative 2015 Canadian Community Health Survey-Nutrition was used. Three dietary index systems based on nutrient profiling models that underpin CAN-FOPL, French FOPL (i.e., Nutri-score), and dietary guidelines for individuals with diabetes (i.e., Diabetes Canada Clinical Practice Guidelines [DCCP]), and two diet-based dietary index systems, Dietary Approaches to Stop Hypertension (DASH) diet and Healthy Eating Food Index-2019 (HEFI-2019), were applied to the dietary data of Canadian adults (n=13,678). Diet quality was examined by assessing linear trends of nutrient consumption across quintile groups of CAN-FOPL dietary index scores. The alignment of dietary index systems was examined using weighted Pearson's correlations and Bland-Altman plots.

Results: The mean±SD dietary index scores (range: 0-100) for CAN-FOPL, Nutri-score, DCCP, DASH, and HEFI diet were 70.3±9.3, 53.6±13.8, 64.1±9.5, 51.7±13.3, and 54.1±14.5 respectively. Moving from the least healthy to the healthiest quintile in the CAN-FOPL dietary index system, intakes of fibre, vitamin A, and potassium increased, while intakes of free sugars, total and saturated fat, calcium, and sodium decreased. CAN-FOPL showed moderate association with DCCP ($r=0.626$, $p<0.001$), Nutri-score ($r=0.507$, $p<0.001$), and HEFI-2019 ($r=0.498$, $p<0.001$) but poor association with DASH ($r=0.235$, $p<0.001$). Bland-Altman plots revealed good agreement between CAN-FOPL and DCCP with a mean difference of 6.2 [95% LOA=-9.8, 22.2], while revealing greater differences compared with Nutri-score (16.6 [-7.1, 40.4]), DASH (18.6 [-9.6, 46.8]), and HEFI-2019 (16.2 [-8.8, 41.2]).

Conclusions: The proposed CAN-FOPL regulations rate the dietary quality of Canadian adults to be healthier than other dietary index systems. Despite the good agreement between the CAN-FOPL and DCCP dietary index systems, wide differences with DASH and HEFI-2019 suggest potential challenges for Canadians to follow a specific dietary pattern with the proposed CAN-FOPL regulations.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

Keywords: Front-of-pack labelling, Dietary index, Nutri-score, DASH, HEFI-2019

OAB(T2)3-2

Is MUAC-only screening and admission good enough for early detection and management of acute malnutrition? Lessons from a retrospective birth cohort in Bangladesh refugee camps

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Background and objectives: For the sake of simplification, active screening with Mid-Upper Arm Circumference (MUAC) below 125mm has become the unique strategy to identify Acute Malnutrition (AM) in children aged more than 6 months. Low Weight-for-Height Z-score (WHZ), a criterion similarly acknowledged as defining AM, is however known to detect an additional number of cases. The large proportion of the caseload missed when using only MUAC has been well described in cross-sectional nutritional surveys. Yet, this is not reflecting the current practice of repeatedly screening the same children with MUAC in the community.

Methods: We have built an unselected retrospective cohort of children in tracking the monthly anthropometric measurements performed as per the Growth Monitoring and Promotion program implemented by ACF since 2009 in the Refugees Camps of Bangladesh. An episode of AM was defined as presence of MUAC below 125mm and/or WHZ below -2, in a child previously free of AM.

Results: Follow-up information was collected for 4131 children born since 2012. In this cohort, 51% of the 2164 AM episodes occurring after 6 months of age were first detected only through WHZ below -2, and 65% of these cases were associated with a short-term history of weight loss, i.e. a decrease in weight during the previous month. In contrast with that, 27% of all AM episodes were first detected only through MUAC below 125mm, and these were associated with an observable weight loss in 35% of the cases. Of note, being measured with a MUAC below 125mm yet with a WHZ above or equal -2 at any point of time after 6 months of age failed to display any significant association with short-term history of weight loss.

Conclusions: Using MUAC below 125mm as the only screening tool, even on a monthly basis, would have missed more than half the caseload of AM episodes occurring from birth till 24 months. Besides, the question also arises as to the possible lack of specificity of MUAC below 125mm as an independent proxy indicator of the rapid loss of body tissue that is supposed to characterise acute malnutrition.

Conflict of Interest Disclosure: No Conflict of Interest to disclose

Keywords: Acute Malnutrition, screening, Weight-for-Height Z-score, Mid-Upper-Arm-Circumference, cohort

OAB(T2)3-3

The Ethiopian Healthy Eating Index (Et-HEI): A tool to evaluate diet quality by assessing the adherence to Ethiopian Food-Based Dietary Guidelines

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Background and Objective: Ethiopia's first Food-Based Dietary Guidelines (FBDG) was officially launched in 2022. This study aims to develop and evaluate the Ethiopian healthy eating index (Et-HEI) for the general population to assess adherence to the FBDG and measure diet quality.

Method: The Et-HEI consists of 11 components, classified as adequacy, moderation, or optimum based on the evidence on diet-disease relationships and contribution to nutrient adequacy. The 11 components are scored between 0 and 10 points to the classified categories. The total Et-HEI scoring ranged from 0 (minimum) to 110 (maximum). Ethiopian women of reproductive age (WRA) were sampled from 494 households of different regions and cities (Amhara, Oromia, Tigray, Southern nations nationality, and Addis Ababa). Two days of 24-hour dietary recall, sociodemographic characteristics, and anthropometric measurements were collected from November to December 2019. For the evaluation, the Et-HEI score was associated with the Minimum Dietary Diversity for Women (MDD-W) and probability of nutrient adequacy. Also, differences in sociodemographic characteristics were assessed over the Et-HEI quartiles.

Results: The Ethiopian WRA consumed a relatively high energy (2570 kcal/day) and protein (1.2 g/kg/day) diet, but they were low in most micronutrients. Their diet primarily consisted of cereals, vegetables, and legumes, with little diversity; women's median Et-HEI and MDD-W scores were 47 out of 110 and 3.5 out of 10, respectively. Almost all women received the maximum score of 10 for sugar and alcohol consumption due to low intakes. Most women did not consume fruits, nuts, or animal-sourced foods, resulting in a median score of 0 for these food groups. The Et-HEI showed an increasing trend in the probability of nutrient adequacy across quartiles except for vitamin B12, niacin, thiamin, and zinc. The women were on average 31 years old, and the majority had no (52%) or primary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(31%) education. Most women (65%) had a normal body weight (BMI: 18.5-25 Kg/m2). Women who completed high school and higher had lower adjusted and unadjusted Et-HEI.

Conclusion: The Et-HEI score was low, indicating the study population's consumption patterns were poor compared to the Ethiopian FBDG. There was also low nutrient adequacy for the selected micronutrients.

Conflict of Interest Disclosure: None.

Further Collaborators: None

Keywords: Healthy diet, Adequate intake, Moderate intake, Optimum intake, Nutrient adequacy

OAB(T2)3-4
Validation of the rapid Prime Dietary Quality Screener (rPDQS), a brief dietary assessment tool with simple traffic light scoring

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Background and objectives: The 2021 American Heart Association dietary guidance emphasized dietary pattern as a determinant of chronic disease. We aimed to validate a brief dietary screener utilizing simple traffic light scoring that could help guide clinical dietary assessment and counseling.

Methods: We surveyed adults (18 years and over) recruited via CloudResearch online platform and sampled to be representative of the U.S. population. The survey included a 13-item rapid Prime Dietary Quality Screener (rPDQS) and demographic information. All participants also completed an Automated Self-Administered 24-hour (ASA24) Dietary Assessment. Responses to rPDQS items were coded using both traffic light and numeric scoring methods and were compared to food groups, Healthy Eating Index 2015 (HEI-2015) scores and usual nutrient intakes estimated from ASA24s. We calculated deattenuated Pearson's correlation coefficients to account for within-person variation in 24-hour diet recalls.

Results: 482 adults completed one ASA24 and rPDQS. Of these, 190 completed a second ASA24 and rPDQS. 50% were female aged 35 years and over, 66% were non-Latino White, 13% non-Latino Black, 16% Latino, and 5% Asian. Positive, statistically significant correlations, ranging from r=0.46 for vegetables to r=0.62 for whole fruits, as well as gradients in mean food group intakes were found for all rPDQS responses relating to food groups that should be encouraged, while negative statistically significant associations, ranging from r=0.26 for red meats to r=0.50 for processed meats, as well as gradients in mean intakes, were found for all rPDQS responses for food groups that should be limited. Total rPDQS scores correlated with total HEI-2015 (r=0.75). Positive, statistically significant correlations were observed between the rPDQS values and the majority of energy-adjusted nutrients including fiber (r =0.72), polyunsaturated-to-saturated fat ratio (r=0.47), magnesium (r=0.69), potassium (r=0.62), vitamin E (r=0.64), folate (r=0.67), vitamin C (r=0.53) and selected carotenoids, including β-carotene (r=0.72), lutein&zeaxanthin (r=0.62), and β-cryptoxanthin (r=0.52). Finally, we found an inverse correlation with total SFAs (r= -0.38).

Conclusions: The rPDQS is a valid, brief dietary screener that identifies clinically relevant patterns of food intake. The simple traffic light scoring system could help clinicians provide brief, actionable dietary counseling during a visit.

Conflict of Interest Disclosure: none.

Further Collaborators: none.

Keywords: diet assessment, diet quality, Prime Diet Quality Score, diet screener

OAB(T2)3-5
Zinc biofortified rice can be an effective measure for combatting zinc deficiency in young Bangladeshi children where rice is staple

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Background and Objectives: Information is needed on zinc absorption from rice cultivars having higher zinc content when conventional rice varieties have been cross-bred with locally available Bangladeshi rice cultivars to enhance their zinc content. Total absorbed zinc (TAZ) from mixed diets containing conventional rice (CR), CR plus zinc fortificant (CR+Zn) or zinc biofortified (ZnBfR) was measured. **Methods**: Forty-seven non-malnourished 36-59 months old children were enrolled in 1 of 2 groups. Using a crossover design, after an one-day acclimatization period in the study ward, children in group A (n = 23) received for 2 days (on study days 2 and 4) a mixed diet containing 150 g CR and on study days 3 and 5 a mixed diet containing 150 g ZnBfR. Children in group B (n = 24) received CR+Zn on study days 2 and 4 and ZnBfR on study days 3 and 5. Fractional zinc absorption (FZA) was measured during each of the diet periods using triple-isotope tracer (oral 67-Zn and 70-Zn; intravenous 68-Zn) ratio technique; TAZ was calculated as the product of total dietary zinc intake (TDZ) and FZA.

Results: TDZ measured from all sources (cooked rice, other foods, tracers, and zinc fortificant) was 4.88, 6.14, and 6.70 mg/d when the children were fed CR-, CR+Zn- and ZnBfR- containing diets, respectively. Mean FZA (% of intake) was 23.0 ± 4.1, 16.9 ± 3.5 and 21.2 ± 4.8 for the respective diets (CR vs ZnBfR: p=0.26; CR+Zn vs ZnBfR: p<0.001; and CR vs. CR+Zn: p<0.001). Mean TAZ

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

from the respective diets was 1.13 ± 0.23, and 1.04 ± 0.20 and 1.40 ± 0.33mg/d. TAZ was not significantly different between CR and CR+Zn diets (p =0.52), but TAZ was significantly greater in ZnBfR when compared with the other two diets (p<0.001 for both).

Conclusions: TAZ from ZnBfR could satisfy daily requirement (3 mg/day) by 47% in children 1-3 years when fed 150g of ZnBfR while it is 28% in 4-8 years. The results confirm that ZnBfR can be a prevention and treatment option for zinc deficiency in young children in population where rice is staple.

Conflict of Interest Disclosure: No author has any conflict of interest.

Further Collaborators: Not applicable

Keywords: Zinc, Biofotified rice, Bangladesh, Zinc deficiency, Young children

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OAB(T2)3-6

Barriers and Facilitators in the Use of Iron and Folic Acid and Vitamin A Supplementation and Improving Dietary Practices: A Qualitative Study in Zinder and Maradi, Niger

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Background and objectives: Consumption away from home (CAFH) represents an increasing share of people's food consumption worldwide, although occurring at different pace and differently according to countries and individuals. Two previous systematic reviews that almost exclusively included studies conducted in high-income countries (HIC) reported that overall CAFH negatively affects individual's diet. To our knowledge there is no systematic review focusing on low and middle-income countries (LMIC). Therefore, the objectives of the present review were: i) to describe CAFH in apparently healthy population in LMIC; ii) to investigate the association between CAFH and energy intake and diet quality.

Methods: A structured search strategy was developed to retrieve peer-reviewed articles published in English from March 2011 until May 2021 in three databases. Of the 475 studies retrieved, 40 met the PICOS criteria and were analysed.

Results: Out of the 12 countries represented in the review, there was an over representation of Brazil, China and Malaysia that accounted for almost three-quarters of the included studies. There was no homogeneity in the definition of CAFH, or in the reference period for which CAFH was reported, making comparisons or synthetises difficult. Overall, several factors such as being a male, being young, high socio-economic status, high education and urbanicity were positively associated with CAFH. Studies investigating energy intake (n=6) reported that a higher CAFH was positively associated with a higher energy intake (up to 35% of total intake). Moreover, CAFH was associated with higher sodium, fats and sugar intakes (n=8). Additionally, studies investigating the association between CAFH and diet (n=16) reported that a high CAFH was associated with poorer diet e.g. western/industrialized dietary patterns, higher consumption of ultra-processed foods, ready meals, alcohol and sweet beverages and poorer diet quality score.

Conclusions: As reported in HIC, CAFH in LMICs is non-negligible and varies greatly according to countries and population under investigation. The drivers of this behaviour, as well as its potential impact on energy intake and diet quality seems similar in LMIC compared to HIC. However, more research is needed on a larger scale in LMIC especially with regard to the potential consequences of CAFH for health.

Conflict of Interest Disclosure: None

Keywords: consumption away from home, low and middle-income countries, diet quality, energy intake

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OAB(T2)4-2

The association between inflammation and infection status and vitamin A status of children 36 – 59 months of in a malaria-endemic rural area in Burkina Faso

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Background and objectives: Infections and micronutrient deficiencies are widespread health issues in Africa. Vitamin A (VA) deficiency remains an endemic public health concern, with its health consequences mostly affecting infants, young children and pregnant and lactating women. In Burkina Faso, VA deficiency is especially prevalent during the rainy season. The aim of this study was to assess the association between common infections and inflammatory status and VA status in children living in a malaria endemic rural area in Burkina Faso, and the effect of season on this association.

Material and methodology: Two community-based cross-sectional studies were conducted in a malaria endemic area of Burkina Faso and have included 115 children of 36 - 59 months of age. The ^{13}C-retinol isotope dilution test (RID) determined VA total body store (TBS) and total liver reserve (TLR). Malaria infection was assessed using rapid diagnosis test and malaria smear, intestinal parasites were assessed by stool microscopic examination, and inflammation indicators, C reactive proteins (CRP) and Alpha-1-acid glycoprotein (AGP) were assessed in

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

venous blood by ELISA. The association between VA status and infection status was tested by a multiple linear regression.

Results: No VA deficiency (≤0.1 mmol/g liver) was detected using sensitive RID method in the study population. TBS median (Q25-Q75) was 430.8 (289.9 – 620.6) mmol and TLR median was 0.79 (0.55 - 1.20) mmol/g liver. One-fourth of study participants were found to have hypervitaminosis A (>1.0 mmol/g liver). Elevated CRP and AGP were respectively detected in 9% and 26% children. Malaria was diagnosed in 10 % of the children. Significant but weak association was found between CRP concentration and VA status (β=0.055, p=0.009). There was no association between malaria status, AGP and exposition to digestive parasites with VA status. The association between CRP and VA status has a seasonal pattern (β= 0.591, p= 0.001).

Conclusion: In this area of Burkina Faso where infections are common none of the children had VA deficiency. An association was found between acute inflammatory markers and VA status, which was stronger during the rainy season.

Conflict of Interest Disclosure: NA

Further Collaborators: NA

Keywords: Vitamin A, Total liver reserves, infections, children, Burkina Faso

OAB(T2)4-3
The association between inflammation and infection status and vitamin A status of children 36 – 59 months of in a malaria-endemic rural area in Burkina Faso

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Background and objectives: Infections and micronutrient deficiencies are widespread health issues in Africa. Vitamin A (VA) deficiency remains an endemic public health concern, with its health consequences mostly affecting infants, young children and pregnant and lactating women. In Burkina Faso, VA deficiency is especially prevalent during the rainy season. The aim of this study was to assess the association between common infections and inflammatory status and VA status in children living in a malaria endemic rural area in Burkina Faso, and the effect of season on this association. **Material and methodology**: Two community-based cross-sectional studies were conducted in a malaria endemic area of Burkina Faso and have included 115 children of 36 - 59 months of age. The ^{13}C-retinol isotope dilution test (RID) determined VA total body store (TBS) and total liver reserve (TLR). Malaria infection was assessed using rapid diagnosis test and malaria smear, intestinal parasites were assessed by stool microscopic examination, and inflammation indicators, C reactive proteins (CRP) and Alpha-1-acid glycoprotein (AGP) were assessed in venous blood by ELISA. The association between VA status and infection status was tested by a multiple linear regression. **Results:** No VA deficiency (≤0.1 mmol/g liver) was detected using sensitive RID method in the study population. TBS median (Q25-Q75) was 430.8 (289.9 – 620.6) mmol and TLR median was 0.79 (0.55 - 1.20) mmol/g liver. One-fourth of study participants were found to have hypervitaminosis A (>1.0 mmol/g liver). Elevated CRP and AGP were respectively detected in 9% and 26% children. Malaria was diagnosed in 10 % of the children. Significant but weak association was found between CRP concentration and VA status (β=0.055, p=0.009). There was no association between malaria status, AGP and exposition to digestive parasites with VA status. The association between CRP and VA status has a seasonal pattern (β= 0.591, p= 0.001). **Conclusion**: In this area of Burkina Faso where infections are common none of the children had VA deficiency. An association was found between acute inflammatory markers and VA status, which was stronger during the rainy season.

Conflict of Interest Disclosure: NA.

Further Collaborators: NA

Keywords: Vitamin A, Total liver reserves, infections, children, Burkina Faso

OAB(T2)4-4
PG-SGA and EORTC to assess Nutritional status and QoL of cancer patients: The Mysore experience

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Background and objectives: Cancer is associated with malnutrition mainly due to disease and treatment induced complications. Early diagnosis of malnutrition risk through nutrition screening followed by comprehensive and timely interventions reduces mortality associated with malnutrition. The Scored Patient-Generated Subjective Global Assessment (PGSGA) method has been proved efficient in identifying cancer patients with nutrition challenges and guiding appropriate interventions. This tool has not been extensively used in the management of cancer patients in India. This study assessed the nutrition and functional status of cancer outpatients receiving treatment at 3 cancer hospitals of Mysuru, India. **Methods**: Adopting a hospital based descriptive cross-sectional approach, 202 Cancer out-patients with confirmed stage 1-4 cancers, physically stable,>18 years, undergoing treatment were recruited and assessed using Scored PG-SGA, EORTC and ECOG tools. Food intake and food frequency data was also obtained. Statistical tests employed were proportions, measures of central tendency and Spearman test.

Results: Among the 202 (M-137, F-65), 98 had Head & Neck (HNC) and 104 had other cancers. Most participants had stage 2, 3 and 4 cancers, only 12.9% of participants were well nourished

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(SGA-A), 59.1% moderately malnourished (SGA-B) and 28% severely malnourished (SGA-C) with significant differences. Functional status and QoL by ECOG and EORTC revealed mild (40.6%) to moderate (36.6%) deficit in the functioning due to disease and treatment induced complications, HNC patients were greatly affected as reflected by a significantly (0.0001) low overall QoL score. Patients with HNC had higher Nutrition impact symptoms due to difficulty in food intake. 24-h recall revealed deficits in energy, protein and carbohydrate while severe deficits were noted in magnesium, potassium, carotene and B-complex vitamins. Nutritional status showed strong inverse correlation (Spearman p=-0.569) with quality of life.

Conclusion Nutritional status assessment and support should be considered a valuable measure within the overall oncology strategy. The PG-SGA is able to identify cancer patients both at risk of malnutrition and those severely malnourished. It also provides a guideline on the appropriate nutrition intervention hence an important tool in nutrition management of cancer patients.

Conflict of Interest Disclosure: No conflict of interest.

Further Collaborators: none

Keywords: Cancer, Nutrition status, Functional status, PG-SGA, Quality of life

OAB(T2)4-5
Wild edible plants importance for dietary diversity in women of reproductive age in rural region of Chad

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Background and objectives: Dietary diversity among women of reproductive age is a proxy of appropriate micronutrients intake, key for their health and development. Wild foods have been suggested as a possible source of this diversity. The objective in this study was to assess the relationship between the Minimum Dietary Diversity for Women of Reproductive age (MDD-W) indicator and the collection of Wild Edible Foods (WEF).

Methods: Our study took place in the region of Guerá (Chad), during March 2019. It was a cross-sectional study in which 984 women were interviewed. Sociodemographic, dietary data, food collection and production, and food security information were obtained. We divided WEF into 4 groups: “Fruits”, “Plants”, “Nuts and Seeds” and “Animals”. MDD-W and the Household Food Insecurity Access Scale (HFIAS) scores were obtained using standard procedures. We created a Food Production Diversity Score (FPDS) to assess households´farm diversity. We did bivariate analyses to evaluate the association between MMD-W and WEF; then carried out a multivariable regression adjusting by education, HFIAS and FPDS.

Results: One in three women achieved MDD-W (32,8%). Fruits were the most collected WEF (75.2%), followed by Plants (38.5%), Animals (10%) and Nuts and Seeds (5%). At least some primary education was present in 51.5% of the households. Average HFIAS was 16.6 with a standard deviation of 5.4, and the average FPDS was 2.9 with a standard deviation of 1,4. The association between MDD-W and the collection of WEF was significant at the bivariable level (p=0.049), as well as the consumption of wild plants (p<0.001) and wild fruits (p=0.04). However, in the multivariable regression only the collection of wild plants remained significant p<0.001, the likelihood to achieve MMD-W among households collecting wild plants was 1.8 (IC95%: 1.3-2.3). The covariates were all significant: HFIAS (OR:0.91; IC95%:0.88-0.94), FPDS 5-8 (OR: 2.0; IC95%: 1.3-3.0) and household education (OR:1.4; IC95%: 1.1-1.9). **Conclusions**: Wild plants have been proved to have a notable association with MDD-W in this region. This must be considered while planning nutrition-sensitive and ecological programmes.

Keywords: Dietary, Micronutrients, Intake, wild foods, nutrition

OAB(T2)4-6
Dietary iodine intake of women of reproductive age living in rural Bangladesh based on the Bangladesh Integrated Household Survey (BIHS) 2015

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Background: Iodine deficiency is a persistent problem among vulnerable population groups in Bangladesh, but there is little insight in dietary sources of iodine intake.

Objective: To estimate dietary iodine intake from food and salt among reproductive-aged women in rural Bangladesh.

Methods: Food composition data for iodine were retrieved from existing databases and literature, based on which a food composition table (FCT) was compiled for Bangladesh. Next, we analyzed household and individual 24-hour recall data from the midline round of the Bangladesh Integrated Household Survey (BIHS-2015) conducted by IFPRI and USAID, from which we selected 15-49 y-old women (n=7,154). We used summary statistics to describe dietary iodine intake by food source, and ANOVA and multiple linear regression to assess associations and differences between sub-groups, such as for pregnancy and lactation status and socio-demographic factors. Intake adequacy was calculated by comparing average dietary intake with the EAR (non-pregnant non-lactating: 95 µg/d; pregnant: 160 µg/d; lactating: 200 µg/d).

Results: The FCT contained 301 food items divided over 13 food groups, being cereals; pulses; edible oil; vegetables; leafy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

vegetables; meat, eggs and milk; fruits; fish (large); fish (small); spices; other food; drinks and beverages; and foods prepared outside the home. Median dietary iodine intake of the study population was 204 µg/day, and most dietary iodine (56%) was derived from iodized salt consumption. Overall, 34% of non-pregnant non-lactating women, 48% of pregnant women, 51% of lactating women, and 55% of those both pregnant and lactating had an intake below their EAR. Iodine intake did not differ significantly between groups defined by pregnancy (p=.19) and/or lactation status (p=.48). Of the socio-demographic factors, region (p<0001), literacy (p<0001), main occupation (p<01), and month of 24-h recall (p<001) explained 10% of the total variation in dietary iodine intake (R^2=.10, p<0001). Iodine intake was lowest in women living in the regions Rangpur (61 µg/d), Rajshahi (125 µg/d), and Khulna (171 µg/d). Iodine intake was furthermore linked to education level and knowledge on iodized foods.

Conclusions: Insufficient iodine intake remains a significant health issue among reproductive-aged women in rural Bangladesh, particularly for those living in the North-West.

Keywords: iodine, Bangladesh, reproductive-aged women, 24-hour recall, food composition data

OAB(T2)4-7
Variability in human milk intake estimation with respect to temperature and humidity assumptions in Dose to Mother technique

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Background: The Dose to Mother (DTM) technique is a stable isotopic method used to safely quantify the human milk intake of babies. A dose of deuterium oxide is administered to the lactating mother, which gets transferred to the breast-fed baby through milk. A two-compartment model is used to mathematically estimate this water transfer, whole body water kinetics, and milk intake. Several assumptions are involved in the computation requiring an examination of the underlying assumptions on the water kinetics and human milk intake estimates.

Methods: We used DTM datasets collected from Bangalore, India. We used data simulation techniques to examine different temperature and humidity conditions and applied more representative values for updating estimates of non-oral and non-milk water intake and fractionation losses. We considered indoor temperature variation from 20°C to 30°C and indoor relative humidity from 40% to 70% as obtained from multiple studies that reported the distribution of indoor temperature and humidity across different parts of the world. The kinetic variables remain unaffected in this simulation exercise.

Results:The non-oral water intake varied from 17.7% to 31.7% of the total water intake and the water loss subject to fractionation varied from 0.7% to 1% of the total water output. The non-milk oral intake estimate of a child with an actual estimate of 91 g/day varied from 72 to 252 g/day over the range of temperature and humidity considered. Fractional water turnover of the mother was 0.11 kg/day, 0.73 kg/day was the oral milk intake of the baby from the mother and the total water loss in baby was 1.26 kg/day.

Conclusions:

Geographical region and seasonal variation in temperature and relative humidity could affect the estimate of human milk intake by the DTM technique. Further research on the effect of local atmospheric conditions on DTM estimates is required.

Keywords: Dose to mother technique, Exclusive Breast feeding

Conflict of Interest Disclosure: NIL.

Further Collaborators: No

OAB(T2)4-8
Correspondence between total whole grain intake and whole grain intake surrogate estimats in the Finnish adult population

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Background and objectives: Whole grain is considered one of the core components in diets promoting health and environmental sustainability. However, inconsistencies in the current whole grain intake estimation possibly weaken the associations between whole grain intake and health outcomes. For example, surrogate estimates (e.g., whole grain bread) have been frequently applied instead of total whole grain intake. Yet, research of these estimates in relation to total whole grain intake is largely missing. We aimed at examining the correspondence of two potential surrogate estimates, dietary fiber and rye bread intake, with total whole grain intake in Finnish adults.

Methods: The data comprised 5094 adults aged 18—74 years participating in the population-based FinHealth 2017 Study. Subgroup analyses were implemented by sex, age (median as cut-off) and education (low/medium vs. high). Dietary intake was assessed by a validated 134-item FFQ. Food, nutrient, energy and whole grain intakes were calculated utilizing the Finnish Food Composition Database Fineli®.

Results: Daily total whole grain intake was 61 g (7.7 g/MJ) in women and 71 g (7.2 g/MJ) in men. The partial (energy-adjusted) Spearman's rank correlation coefficients were 0.68 between total whole grain and dietary fiber intake and 0.83 between total

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

whole grain and rye bread intake. Total whole grain had a higher correlation with dietary fiber in men than women (0.75 vs. 0.64, $p< 0.0001$) and in low/medium educated than high educated participants (0.70 vs. 0.66, $p<=0.03$). The correlation between total whole grain and rye bread intake did not differ between subgroups. No differences appeared between age groups. Of the participants, 88% were categorized in the same or adjacent quintile by unadjusted total whole grain and dietary fiber intakes, while the proportion regarding total whole grain and rye bread intake was 93%.

Conclusions: Overall, rye bread appears to be a good surrogate for whole grain in Finnish adults. Dietary fiber also corresponded reasonably well to whole grain intake. However, consideration of sex and education in applying dietary fiber is needed when examining whole grain intake in relation to health outcomes. Further research is warranted in other populations as dietary sources for whole grains differ across countries.

Keywords: Cereals, Dietary fiber, Intake, Rye bread, Whole grain

Further Collaborators: Legumes for sustainable food system and healthy life (Leg4Life) project study group. This research was funded by the Juho Vainio Foundation [grant number 202200116] and the Strategic Research Council at the Academy of Finland [grant numbers 327698; 327699].

OAB(T2)5-1
Can body composition and food structure affect glycemic variability?

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Background and objectives: Postprandial glycemic homeostasis provides holistic insights into glucoregulatory mechanisms in vivo. However, the reproducibility of these measurements has become increasingly challenged. At present, there is paucity in clinical evidence investigating the stability of acute glycemia, particularly for the Asian phenotype. The present research aims to critically evaluate the intra- and inter-individual reliability of postprandial glycemic indicators, and examine potential factors underlying the observed inconsistencies.

Methods: This is a secondary analysis of combined data from three crossover acute trials (n=62) adopting a similar protocol. Healthy, young Singaporean adults (29 ± 10 years) were administered glucose (50 g) in triplicate and capillary blood was collected at regular intervals for glucose analysis. The test was repeated with other high-carbohydrate foods (sucrose, isomaltulose, jasmine/Bapatla white rice, Bapatla brown rice, mee pok noodle, semolina spaghetti/penne and wholegrain spaghetti/penne; available carbohydrate matched) without replicates. Fasting plasma insulin, anthropometry, body composition (bioelectrical impedance) and blood pressure were additionally measured.

Results: Intra-individual consistencies (i.e. for glucose profile, plasma insulin and insulin resistance) were largely moderate according to the respective intraclass-correlation coefficients (ICCs). Specifically, intra-individual variability was highest at 15 min (ICC: (95 % CI): 0.47 (0.32, 0.61)) and lowest at 60 min (0.71 (0.60, 0.80)). There were also no clear improvements in consistency after an extended postprandial duration (incremental area under curve; $iAUC_{120min}$ ICC: 0.58 (0.44, 0.70), $iAUC<_{180min}$ ICC: 0.53 (0.39, 0.57)). Among the demographic, anthropometric and cardio-metabolic health-related indicators, intra-individual relative variability (for $iAUC_{120min}$) was positively correlated with BMI ($r_{Pearson's}$: 0.383; P = 0.002) and fat-mass index ($r_{Pearson's}$: 0.315; P = 0.010). Moreover, a food's structure and nutritional profile could also influence inter-individual rank-order stability (between the $iAUC_{120min}$ for glucose and a range of test foods). Compared to minimally processed foods like jasmine white rice, glycemic variability was prominent for more complex food systems such as pasta.

Conclusions: Postprandial glycemia is vulnerable to variability. This is particularly prominent among individuals with increased adiposity and may also be influenced by the nature and complexity of the food administered. Collectively, this emphasizes the need for a careful re-evaluation on the utility of these existing clinical tools.

Keywords: Glucose, Glycemic index, Methodology, Postprandial, Reproducibility of results

Conflict of Interest Disclosure: The authors have no conflicts of interest to disclose.

Further Collaborators: There are no further collaborators for this research.

OAB(T2)5-2

Self-Reported DHA Supplementation during Pregnancy and Its Association with Obesity or Gestational Diabetes in Relation to DHA Concentration in Cord and Maternal Plasma: Results from NELA, a Prospective Mother-Offspring Cohort

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Background and objectives: Maternal supplementation of docosahexaenoic acid (DHA) during pregnancy has been recommended due to its role in infant development, but its effect on materno-fetal DHA status is not well established. We evaluated the associations between DHA supplementation in pregnant women with obesity or gestational diabetes mellitus (GDM) and maternal and neonatal DHA status.

Methods: Serum fatty acids (FA) were analyzed in 641 pregnant women (24 weeks of gestation) and in 345 venous and 166 arterial cord blood samples of participants of the NELA cohort.

Results: Obese women (n = 47) presented lower DHA in serum than those lean (n = 397) or overweight (n = 116) before pregnancy. Linoleic acid in arterial cord was elevated in obese women, which indicates lower fetal retention. Maternal DHA supplementation (200 mg/d) during pregnancy was associated with enhanced maternal and fetal DHA levels regardless of pre-pregnancy body mass index (BMI), although higher arterial DHA in overweight women indicated an attenuated response. Maternal DHA supplementation was not associated with cord venous DHA in neonates of mothers with GDM. The cord arteriovenous difference was similar for DHA between GDM and controls.

Conclusions: Maternal DHA supplementation during pregnancy enhanced fetal DHA status regardless of the pre-pregnancy BMI while GDM may reduce the effect of DHA supplementation in newborns.

Keywords: Obesity, Docosahexaenoic acid, Diabetes, Pregnancy, Supplementation

Conflict of Interest Disclosure: All authors declare no conflict of interest.

OAB(T2)5-3

Dietary restriction in normal weight-individuals: using a web-based 24-hour dietary recall during 2 weeks

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Background and objectives: Previous studies have found that higher levels of dietary restriction is associated with relatively lower *ad libitum* food intake (Graham et al., 2014). The present study aimed at assessing dietary restriction and its association with dietary patterns in a community-based sample of adults by using a standardized dietary assessment method.

Methods: A total of 105 women (M_{age} = 30.30 ± 9.04) with normal body weight according to body mass index (M_{BMI} = 23.43 ± 4.34) completed the Automated Self-Administered 24-Hour (ASA24®) Dietary Assessment Tool over a two weeks period in their natural settings as well as the Three-Factor Eating Questionnaire.

Results: Compared to women with low levels of dietary restriction, women with high levels of dietary restriction reported higher intake of fruit juice, citrus and non-citrus juices ($F= 4.86$; $p<0.05$; $\eta2= 0.08$), higher intake of yogurt ($F= 5.02$; $p<0.05$; $\eta2= 0.09$) and higher intake of alcoholic beverages and alcohol ($F= 8.24$; $p<0.01$; $\eta2= 0.13$). Higher levels of dietary restriction were associated with a higher consumption of dark green, red and orange vegetables, higher consumption of alcoholic beverages and alcohol and lower consumption of seafood (finfish, shellfish, other seafood) high in 3 fatty acid as well as lower consumption of refined grains. In addition, a higher dietary restriction mean score was found in those women who consider themselves to be healthy eaters. The regression analysis found that dietary restriction was associated with a lower intake of seafood high in omega 3 fatty acids ($B=-1.64$; $p < 0.01$).

Conclusions: The current study may be helpful for demonstrating which foods may likely to be associated with dietary restriction. Nutritional interventions should be considered to benefit dietary patterns of adults.

Keywords: dietary restriction, food intake, Automated Self-Administered 24-Hour (ASA24®) Dietary Assessment Tool, normal weight

Conflict of Interest Disclosure

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T2)5-4

Multi-country validation of standard minimum dietary diversity indicators as proxies for micronutrient intake in school-aged children

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Background and objectives: Micronutrient deficiencies impair school-aged children's physical and mental development, yet data on micronutrient intake in this population remain scarce, particularly in low- and middle-income countries. As assessing micronutrient intake relies on time and skills-intensive quantitative dietary assessment, there is a need for more operational indicators to monitor diet adequacy in this age group. The present study aimed to conduct a multi-site evaluation of the performance of two food group scores (FGS) and related dichotomous indicators (DI), previously validated in women of reproductive age and 6-to-23-month-old children, in predicting micronutrient intake and its adequacy in 4-to-8-year-old children.

Methods: We conducted secondary data analysis of six 24-hour recall datasets, collected in 4 African countries (Burkina Faso, Malawi, Uganda, and Zambia) and 2 Indian states (Gujarat and Maharashtra), including 7,042 children aged 4-8 years. Micronutrient adequacy was assessed by the Mean Probability of Adequacy (MPA) of intake over 11 micronutrients. Predictors of MPA were FGS-10 (10 food groups from the FAO/FHI360 Minimum Dietary Diversity (MDD) for Women guidelines), and related MDD-W (FGS-10>=5); and FGS-8 (8 groups from the WHO IYC Feeding MDD guidelines), and related MDD-IYC (FGS-8>=5).

Results: Mean MPA and FGS were higher in Uganda (Mean MPA=0.69±0.15; FGS-10=4.7±1.4; FGS-8=4.0±1.0) and Zambia (0.67±0.17; 4.8±1.2; 4.1±0.8), lower in Gujarat (0.28±0.14; 2.8±0.7; 2.8±0.7), and intermediate in Malawi (0.36±0.21; 3.7±1.2; 3.2±0.9), Burkina Faso (0.39±0.24; 3.1±1.0; 3.0±0.9) and Maharashtra (0.36±0.20; 3.9±1.4; 3.6±1.0). FGS-10 and FGS-8 were positively associated with MPA in all sites (correlation coefficients=0.34-0.58, p-values<0.001). Area under the receiver operating characteristic curve values were moderate to good (0.63-0.82) for both FGS as predictors of MPA>=0.7, except for Gujarat where no child reached this level of MPA. MDD-W was the best DI for Burkina Faso, Malawi, Uganda and Zambia, while FGS-10>=6 was better for Maharashtra. For Burkina Faso, Maharashtra and Malawi, MDD-IYC was the best DI, but FGS-10>=4 was more suitable for Uganda and Zambia.

Conclusions: FGS-10 and FGS-8 are simple proxies to monitor diet adequacy in 4-to-8-year-old children. When DI are deemed necessary, MDD-W and MDD-IYC may be used in African settings. For Indian contexts similar to Maharashtra, higher cut-offs might be considered.

Keywords: Low- and middle-income countries, Micronutrient adequacy, Validation

Conflict of Interest Disclosure: The authors have no conflict of interest.

OAB(T2)5-5

The effects of oral ferrous bisglycinate supplementation on hemoglobin and ferritin concentrations in adults and children: A systematic review and meta-analysis of randomized controlled trials

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Background: Iron deficiency and anemia have serious consequences, especially for children and pregnant women. Iron salts are commonly provided as oral supplements to prevent and treat iron deficiency, despite poor bioavailability and frequently reported adverse side effects. Ferrous bisglycinate is a novel amino acid iron chelate that is thought to be more bioavailable and associated with fewer gastrointestinal (GI) adverse events as compared to iron salts.

Objective: We conducted a systematic review and meta-analysis of randomized controlled trials (RCTs) to evaluate the effects **of ferrous bisglycinate supplementation** as compared to other iron supplements on hemoglobin and ferritin concentrations and GI adverse events.

Methods: A systematic search of electronic databases and grey literature was performed up to July 17, 2020, yielding 17 RCTs that reported hemoglobin or ferritin concentrations following at least 4 weeks supplementation of ferrous bisglycinate compared to other iron supplements in any dose or frequency. The search was registered in PROSPERO (CRD42020196984).

Random-effects meta-analyses were conducted among trials of pregnant women (*n*=9) and children (n=4); pooled estimates were expressed as standardized mean differences (SMDs). Incidence rate ratios (IRR) were estimated for GI adverse events using Poisson generalized linear mixed-effects models. The remaining trials in other populations (*n*=4; men and non-pregnant women) were qualitatively evaluated.

Results: Compared with other iron supplements, supplementation with ferrous bisglycinate for 4-20 weeks resulted in greater SMDs (95% CI) in hemoglobin concentrations in pregnant women (0.54 [0.15, 0.94] g/dL; p<0.01) and fewer reported GI adverse events (IRR [95% CI]: 0.36 [0.17, 0.76]; p<0.01). There were minimal differences for outcomes of ferritin in pregnant women and children or hemoglobin in children.

Conclusions: Ferrous bisglycinate shows some benefit over other iron supplements in increasing hemoglobin concentration and reducing GI adverse events among pregnant women. More trials are needed to assess the efficacy of ferrous bisglycinate against other iron supplements in other populations.

Keywords: Iron, Anemia, Supplementation, Systematic review, Ferrous bisglycinate

Conflict of Interest Disclosure: None.

Further Collaborators: None.

OAB(T3)1-1
Wholegrain intake, growth and metabolic markers in Danish infants and toddlers – a longitudinal study

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Background and objectives: wholegrain intake is linked to lower risk of lifestyle diseases, but little is known about its role in diet, growth and metabolic health during the first years of life. We characterized wholegrain and dietary fibre intake in 439 Danish children at 9 and 36 months of age and explored associations with height z-scores (HAZ), body mass index z-scores (BMIZ) and metabolic markers.

Methods: we used pooled data from two infant cohorts and estimated intakes of total wholegrain, dietary fibre and wholegrain subtypes from 7-day dietary records. Associations with HAZ, BMIZ and non-fasting plasma low-density (LDLC) and high-density-lipoprotein cholesterol, triacylglycerol, insulin and glucose were analysed in mixed models, adjusted for potential confounders.

Results: median (25th, 75th percentile) wholegrain intake was 7.5 (4.9, 10.5) and 6.5 (4.6, 9.0) g/MJ at 9 and 36 months. Neither wholegrain nor dietary fibre intake were associated with HAZ (P<=0.09). At 36 months, wholegrain intake was inversely associated with LDLC (P=0.05) and directly with glucose (P<0.001). In secondary analyses, wholegrain rye was inversely associated with glucose at 9 months and insulin at 36 months (both P=<0.03). Oat and wheat wholegrain were directly associated with glucose (both P=<0.01) and wheat with BMIZ (P=0.02) at 36 months.

Conclusion: Danish infants and toddlers have high intakes of wholegrain and dietary fibre, with no indication of compromised growth. In line with studies in adults, wholegrain intake was inversely associated with LDLC. The observed direct association between wholegrain intake and plasma glucose and associations with wholegrain subtypes should be investigated further.

Keywords: Dietary fibre, Young children, Biomarkers, Cholesterol, Growth

Conflict of Interest Disclosure: None of the authors reported a conflict of interest related to the study.

OAB(T3)1-2
Effect of optimal feeding practices on child development at 2y and 6-7y: a path analysis within the Vietnamese cohort

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Background and objectives: Optimal feeding practices are critical for child growth and development, yet limited evidence exists on the long-term effects of early feeding on child development. This study examined the relationships between infant feeding practices and child development at 2y and 6-7y.

Methods: We analyzed data of 726 children whose mothers participated in a randomized controlled trial of preconception supplementation in Vietnam. Early initiation of breastfeeding (EIBF), exclusive breastfeeding (EBF) in the first 6 months of age, and minimum dietary diversity at aged 1y were assessed based on WHO guideline. Child development was measured by the Bayley Scales of Infant Development-III at 2y and the Wechsler Intelligence Scale for Children®—IV at 6-7y. We used multivariable regression and structural equation models to examine the relationships between infant feeding practices and child development at 2y and 6-7y.

Results: Breastfeeding was suboptimal; 52% of children had EIBF and 62% had EBF. Mean breastfeeding duration was 18 months and 80% achieved diverse diet (at least 4 food groups) at aged 1y. Optimal breastfeeding practices were positively associated with motor development at 2y (β= 0.20, 95%CI: 0.04, 0.35 for EIBF and 0.14, 95% CI: -0.02, 0.30 for EBF) and cognitive development at 6-7y (β= 0.23, 95%CI: 0.09, 0.38 for EBF). EIBF was directly associated with motor and cognitive development at 2y (β= 0.17, 95%CI: 0.03, 0.32 for motor and 0.12, 95%CI: -0.02, 0.26 for cognition) which in turn were associated with cognitive development at 6-7y (β= 0.11, 95%CI: 0.05, 0.18 for motor and 0.26, 95% CI: 0.20, 0.33 for cognition). The indirect path mediated by motor and cognitive development at 2y explained 33-40% of the relationship between EIBF and cognitive development at 6-7y. We also found a direct association of EBF with cognitive development at 6y (β=0.23, 95% CI: 0.09, 0.37). There were no significant associations between breastfeeding duration or dietary diversity with child development.

Conclusions: Breastfeeding practices during infancy directly and indirectly affected child development at early and middle childhood. Interventions to support optimal breastfeeding practices during infancy are needed to promote learning readiness as children begin formal schooling.

Keywords: Breastfeeding, Child development, Early and middle childhood

OAB(T3)1-3

The relationship between dental caries, sweet treat consumption and overweight: a longitudinal study in school-aged children

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Background and objectives Dental caries and obesity are highly prevalent chronic conditions in industrialized countries and appear to carry a shared risk factor, that is, dietary sugar. This study aims to examine the longitudinal relationship between caries and overweight in school-aged children, and define the role of select sugary drinks and foods ("sweet treats") in that relationship.

Methods We utilized data from the Finnish Health in Teens cohort study and included 3863 children with a mean (SD) age of 11.1 (0.8) years at baseline recruitment and information available on history of cavitated caries lesions (decayed, missing, and filled teeth on permanent dentition, DMFT) and body mass index (BMI). Children with DMFT = 0 were considered caries-free and those with DMFT>0 as having caries. Based on the BMI, measured at baseline and follow-up, we categorized the children into two groups: non-overweight or overweight according to age- and sex-specific cutoffs. Only children who were non-overweight at baseline were included in the study. We estimated weekly consumption frequency of sweet treats as a sum score. Using Cox regression, we defined the crude relationship between dental caries and risk of overweight at follow-up (model 1), and further considered the role of sweet treat consumption (model 2) and other possible confounders (demographics and physical activity; model 3) in that relationship, shown as hazard ratios (HR) with 95% confidence intervals (CI).

Results Mean DMFT index was 0.7 (1.5). Of the children, 29.1% (n = 1126) had history of caries, and 5.6% (n = 217) became overweight during the mean follow-up time of 2.6 (0.8) years. Caries was not associated with becoming overweight either in the crude model (HR 1.07, 95% CI 0.81–1.42) or in the models controlled for sweet treat consumption (0.94, 0.80–1.24) or other possible confounders (0.94, 0.68–1.20).

Conclusions This sample of school-aged children was caries-wise fairly healthy. Caries was not associated with development of overweight, and controlling the analysis for sweet treat consumption and other factors did not change that. Analyses should be repeated in populations with a poor caries status and with a longer follow-up time.

Keywords: sugar, dental caries, obesity, childhood, longitudinal

Conflict of Interest Disclosure: None.

OAB(T3)1-4

Growth patterns and factors associated with overweight/obesity among infants at the age of 2 years: Findings from a cohort study in Malaysia

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Background and objectives: Childhood obesity is a global public health issue and is associated with obesity and its related diseases in adulthood. This study aimed to determine growth patterns and factors associated with overweight/obesity among infants at the age of 2 years.

Methods: This cohort study followed-up 117 at-term infants from birth to 2 years in Seremban, Malaysia. Maternal pre-pregnancy BMI, infant's sex, gestational age, birth weight and length were obtained from patient health clinic card. Mothers were interviewed on infant feeding practices and infant's dietary intake. Weight and length were measured every 6 months from 6-24 months. Weight-for-length z-score (WLZ) was determined and a WLZ of >+1 SD was categorized as being overweight/obese.

Results: The prevalence of overweight/obesity at the age of 2 years was 9.4%. WLZ increased at a rate of 0.11 over the first 2 years of life (*B*=0.11, *SE*=0.04, *p*<.01). Infants with low WLZ at birth had a more rapid linear increase in the WLZ over time (*B*=-0.23, *SE*=0.07, *p*<.01). None of the infants who were overweight/obese at 2 years was overweight/obese at birth, but 36.4% of them became overweight/obese at 6 months of age. Overweight/obese infants had higher dietary diversity score (*M*=5.27, *SD*=1.19 vs *M*=4.35, *SD*=1.42) and higher energy intake (*M*=1112 kcal, *SD*=126 vs *M*=1002 kcal, *SD*=133) than infants who were not overweight/obese at 2 years (*p*<.05). Being overweight/obese at 6 (Adj OR=6.75, 95% CI=1.58-28.76), 12 (Adj OR=15.32, 95%CI=2.99-78.47) and 18 (Adj OR=15.57, 95%CI=2.96-81.90) months, and higher dietary diversity score at 2 years (Adj OR=1.78, 95%CI=1.03-3.07) were associated with higher likelihood of being overweight/obese at 2 years.

Conclusions: Overweight/obesity developed at the age of 6 months and continued throughout the complementary feeding period. Infants receiving a wide variety of foods were at higher risk of being overweight/obese at 2 years. Proper complementary feeding is important for healthy growth of infants.

Keywords: Growth, Overweight, Obesity, Dietary Diversity, Infants

Conflict of Interest Disclosure: The authors have no conflict of interest.

OAB(T3)1-5

Infant feeding practices and risk of allergic diseases and sensitisation during the first year of life – a birth cohort study

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Background and objectives: Allergic diseases are one of the most common and earliest developing health issues in early childhood. Growing evidence shows that allergic diseases, which occur more frequently in developed countries, are increasing in developing countries. Infant feeding is one of the major environmental exposures that affects the immune system and the subsequent risk of childhood allergies. This study aims to determine whether compliance with WHO recommendations for infant feeding is protective against allergy risk during the first year of life.

Methods: This prospective cohort study included 380 mother-child pairs recruited from selected public health clinics at the state of Selangor and the Federal Territory of Kuala Lumpur, Malaysia. Infant feeding practices and allergic outcomes including eczema, food allergy, and wheeze were assessed at 3, 6, and 12 months of age based on parental reports. Food and inhalant allergen sensitisation were assessed based on serum allergen-specific IgE test. **Results:** About 46.6% of the infants were exclusively breastfed until 6 months, 97.1% had timely initiation of complementary feeding, 10.5% met minimum dietary diversity (MDD) at 6 months, and 54.5% met MDD at 12 months. A total of 27.6% of the infants had eczema, 3.8% had IgE-mediated food allergy, 6.1% had wheeze, 27.4% had food sensitisation, and 10.8% had inhalant allergen sensitisation during the first year of life. After adjustment for confounding variables, results from the multivariable generalised linear mixed model showed that higher odds of food sensitisation were found in infants who met MDD at 6 months (OR = 2.34, 95% CI = 1.04-5.28). No associations were found between exclusive breastfeeding and introduction of complementary feeding with allergic outcomes.

Conclusions: The present study does not support an association between exclusive breastfeeding and timely initiation of complementary feeding with allergic outcomes in infants during the first year of life. Infants introduced to a high diversity of foods at 6 months had an increased risk of food sensitisation at 12 months. More studies in developing countries are needed and the underlying mechanisms should be explored to provide evidence for infant feeding recommendations for allergy prevention.

Keywords: Allergic diseases, Sensitisation, Feeding practices, Diet diversity, Infants

Further Collaborators: the MICOS Research Group (Siti Huzaifah Mohammed Hussien, Muliana Edi, Meng Lee Tan, Farhan Hassan Shazalli)

OAB(T3)1-6

Longitudinal changes in body composition in term South Indian infants with different growth patterns during early infancy.

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Background: Growth and body composition trends during early life have both short and long-term implications- especially in Indians, who are postulated to have the "thin, fat phenotype". However longitudinal studies using accurate methods to measure body composition during early life in Indian infants, based on their growth trajectories are scarce.

Objectives: To assess longitudinal changes in body composition during early infancy in term South Indian infants, categorised by their growth pattern at 6-months of age.

Methods: Two hundred and twenty-three term healthy new-borns were longitudinally followed from birth to 6-months of age. Anthropometric measurements, maternal details and feeding practices were assessed sequentially at birth, 1.5, 3.5 and 6-months. Body composition was measured using air-displacement plethysmography (PEA POD, Software version 3.5.0, 201, COSMED USA) at each timepoint. The infants were categorised as: catch-down growth (CDG), steady growth (SG), and catch-up growth (CUG), based on the decrease/increase in WHO weight for age z-score by 0.67 SD from birth to 6-months. Linear mixed model was performed to evaluate longitudinal changes in %fat mass (FM) across the growth categories.

Results: About 79% of infants were appropriate for gestational age (AGA) and 21% were small for gestational age (SGA), defined by INTERGROWTH new-born size standards. The prevalence of CDG, SG and CUG were 22%, 48% and 30%, respectively. The proportion of CUG was significantly higher in SGA babies compared to AGA (47.8% vs 25.4%, $p<0.001$), while CDG was higher in AGA babies compared to SGA (25.4% vs 6.5%, $p<0.001$). The %FM estimates were significantly lower in the CUG infants at birth compared to SG infants (8.9 ± 3.8% vs 11.2 ± 3.4%), but higher than SG group at 6 months of age (29.0 ± 5.2% vs 26.2 ± 4.7%). The %FM accretion from birth to 6-months was significantly higher in CUG infants by 1.8%, compared to SG infants. The higher fat accretion between CUG and SG was noted in both SGA and AGA infants.

Conclusion: The %FM accretion was higher in the CUG group, compared to SG group at 6-months of age, indicating preferential fat growth in these infants.

Keywords: Air displacement plethysmography, Early infancy, Body composition, Weight for age Z score, Catch up growth

Conflict of Interest Disclosure: All authors declare no conflict of interest.

OAB(T3)1-7

Long-term whole egg supplementation promotes growth and *Bifidobacterium* and *Lachnospira* genus, without increases blood cholesterol levels in primary school children.

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Background and objectives: Protein-energy malnutrition is a major nutritional problem in the world. The lack of enough quantity or quality of protein intake negatively affects growth and development, especially in children. A school lunch program has been used to ameliorate the burden of malnutrition in Thailand since 1952. However, today over 20 % of children are still stunted and wasted, particularly in rural areas. One egg contains an excellent source of proteins and nutrients with a cheap price. We investigated the long-term effects of egg supplementation on growth, biochemical indexes, and microbiota in primary school children.

Methods: A randomized controlled, cluster experimental study was performed at 6 rural schools in Central, Eastern, and Western Thailand. 635 students (8 - 14 years old) were recruited. Subjects were randomly assigned into 3 groups, based on weight for age: 1) Whole eggs (WE) - consume 10 additional eggs per week [n = 238] 2) Egg substitute (ES) - consume yolk-free egg substitute equivalent to 10 eggs per week [n = 200], and 3) control group (C, [n = 197]). The anthropometric, biochemical indexes, and microbiota were measured at week 0, week 13th, and week 35th.

Results: At baseline, 14% were under-weighed, 9% were stunted, and 16% were wasted. At 35th weeks, weight and height changes were markedly increased in WE compared with C (3.56 ± 0.93 kg, p<0.001 and 5.11 ± 0.92 cm, p<0.001). No significant differences in weight and height were observed between the ES and C groups. Prealbumin levels were higher (1.53 ± 0.33 mg/dL, p<0.001) in WE but not ES as compared with C. There were significant decreases in total cholesterol, triglycerides, and LDL cholesterol in WE but not ES as compared with C. Additionally, HDL cholesterol tended to increase in WE (0.66 ± 0.99 mg/dL, *ns*) as compared with C. *Bifidobacterium* and *Prevotella* were significantly increased in relative abundance amounts in WE. The differential abundance analysis also indicated that *Lachnospira* significantly increased and *Varibaculum* significantly decreased after whole egg supplementation.

Conclusions: Long-term whole egg supplementation significantly improves growth in children, which simultaneously promotes health-benefit gut bacteria.

Keywords: Malnutrition, whole egg consumption, primary school students, growth, microbiome

Conflict of Interest Disclosure: The authors declare no conflict of interest.

OAB(T3)1-8

Association between child anthropometry and inattention and hyperactivity among early school age children in rural Nepal.

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Background and objectives: To study the association between child height-for-age (HAZ) and body mass index (BMI) z-scores and behavioral difficulties among school-age children in rural Nepal.

Methods: In a cohort follow-up of children 7 to 9 years of age (n=1,927), whose mothers participated in a randomized trial of micronutrient supplementation, and who were subsequently enrolled in a preschool micronutrient supplementation trial, we assessed behavior using the Conners' Parent and Teacher Rating Scales-Revised (CPRS-R and CTRS-R). Psychometric analyses revealed a two-factor model capturing behavioral domains of "inattention" and "hyperactivity/oppositionality". Summary scores derived from the two-factor models were transformed to t-scores and dichotomized with the bottom two tertiles as "low" and the top tertile as "high", indicating more behavioral difficulties. Logistic regression was used to examine the association of HAZ and BMIZ on behavioral outcomes before and after adjusting for socioeconomic status, HOME Inventory score, and child schooling history. **Results**: Mean (SD) HAZ and BMIZ was -1.88 (0.86) and -1.18 (0.82). In unadjusted models, higher HAZ was associated with lower odds of parent-reported inattention and hyperactivity/oppositionality (OR: 0.82, 95%CI: 0.71, 0.93; OR: 0.86, 95%CI: 0.76, 0.97), and teacher-reported hyperactivity (OR: 0.78, 95%CI: 0.68, 0.90). After adjusting for child age, sex, supplement allocation in both trials, and household socioeconomic status, a one-unit increase in HAZ was associated with a 16% and 21% reduction in the odds of parent-reported inattention (OR: 0.84, 95%CI: 0.73, 0.97) and teacher-reported hyperactivity (OR: 0.79, 95%CI: 0.60, 0.90), respectively. Adjusting for HOME scores and pre-primary schooling attenuated the association between HAZ and parent-reported inattention (OR: 0.88, 95%CI: 0.76, 1.02) and hyperactivity/oppositionality (OR: 0.96, 95%CI: 0.84, 1.11), suggestive of a protective effect of these factors. However, higher HAZ remained significantly associated with lower odds of teacher-reported hyperactivity in fully adjusted models (OR: 0.81, 95%CI: 0.70, 0.94). BMIZ was not associated with any behavioral outcomes.

Conclusions: Lower HAZ is associated with higher inattention and hyperactivity/oppositionality in school-age children in Nepal, a risk mitigated by the home environment and pre-primary schooling. These findings reinforce the need for multi-sectoral interventions to improve child nutrition and development.

Keywords: stunting, child behavior, inattention, hyperactivity, child nutrition

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

OAB(T3)3-1

Dietary pattern with more fruits and vegetables in children of recent U.S. immigrants is associated with better nutrient intake and weight status

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Background and objectives: With increased time residing in the US, the risk for developing obesity is increased among immigrant adults and their children. It is unclear, however, if certain dietary patterns contribute to this risk. This study examines whether a more healthful dietary pattern is associated with improved nutrient intake and weight status in children of recent immigrants from Brazil, Haiti, and Latin American countries.

Methods: This cross-sectional analysis used baseline data from children of families (n=239) who participated in Live Well, a randomized controlled trial targeting recent immigrant families in Greater Boston, MA., between 2009 and 2011. Food group and nutrient intake were assessed using the Block 2007 Food Screener. Children's weight and height were measured. Dietary patterns were derived from food group data using principal component analysis. Each child was assigned a factor score quartile based on the agreement with each dietary pattern, with Q4 being the highest and Q1 being the lowest. Multiple linear regression examined the association between quartiles for dietary patterns and nutrient intake, and multiple logistic regression examined the association between quartiles for dietary patterns and odds of being overweight/obese. Models were adjusted for total energy intake and other covariates.

Results: The prevalence of overweight/obesity in this population (age 6.2 ±2.6 years) is 46.9%. Two dietary patterns emerged: “Meals and Sweets” (MS) and “Fruits and Vegetables” (FV). Children in Q4 for FV had a lower percentage of energy from fat (p<.01), lower saturated fat, lower added sugar, higher iron (p<.05), higher dietary fiber, and higher potassium intake (p<.001) than those in Q1. Children in Q4 also had lower odds of being overweight/obese than those in Q1 (OR= 0.29; 95% CI = 0.11 – 0.79). Less favorable nutrient intake was observed for MS with no association with odds of being overweight/obese.

Conclusions: A dietary pattern characterized by more fruits and vegetables was associated with improved nutrient intake and decreased odds of being overweight/obese in children of recent immigrants. Further studies should confirm these findings and explore the relationship between dietary patterns among mother-and-child dyads to see whether similar results occur across generations.

Keywords: dietary pattern, dyads, nutrient intake, obesity, overweight

Conflict of Interest Disclosure: There is no potential conflict of interest to disclose.

OAB(T3)3-2

The effects of maternal iodine nutrition during pregnancy on their infants' physical development

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Background and objectives: Physical development is a crucial indicator for revealing the growth and development of infants. While iodine deficiency or excess during pregnancy for their infants' physical development has scarcely been studied. This prospective cohort study aimed to evaluate the effects of maternal iodine nutrition during pregnancy on their infants' physical development.

Methods: From March 2016 to December 2018, mother-infant pairs from Tanggu, Tianjin and Wuqiang, Hebei were recruited in this prospective cohort study. Blood and urine samples were collected to determine thyroid function and urinary iodine concentration (UIC) during pregnancy. Infants' weight, length and head circumference were measured at 18-24 months

Results: A total of 469 mother-infant pairs were included in this study. There were 245 boys (52.2%) and 224 girls (47.8%). The average pregnancy age, gestational week and infants' age were 28.6 ± 3.1 years, 39.5 ± 1.3 weeks and 20.9 ± 3.0 months, respectively. Maternal and infants' median UIC was 161 (111, 251) μg/L and 217 (121, 361) μg/L, suggesting iodine sufficiency according to WHO/UNICEF/ICCIDD-recommended criteria. The Z-score of HC for age of infants with UIC in 100-149 μg/L during pregnancy was higher than those with UIC<100 μg/L and 150-249 μg/L, the difference was 0.56 and 0.46 (*P*=0.002, *P*=0.007), respectively. While no difference was found in maternal UIC and infants' length and weight. There was no difference between maternal thyroid function and infants' physical development.

Conclusions: The Z-score of HC for age was higher in infants with maternal UIC within 100-149 μg/L, rather than 150-249 μg/L, which imply that the criteria recommended by

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

WHO/UNICEF/ICCIDD may be a little high for Chinese pregnant women with such background of iodine nutrition.

Keywords: Pregnancy, Infants, Urinary iodine concentration, Thyroid function, Physical development

OAB(T3)3-3
Health behavior clusters, temperament and weight status among Finnish preschoolers

Qi Jin[1], Wanqi Zhang[1,3,4], Wen Wu[1], Yanting Chen[1,2], Wenxing Guo[1], Ziyun Pan[1], Wen Chen[1], Kexin Zhang[1], Naifan Zhang[1], Ying Yang[1]

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Conclusions: The Z-score of HC for age was higher in infants with maternal UIC within 100-149 μg/L, rather than 150-249 μg/L, which imply that the criteria recommended by WHO/UNICEF/ICCIDD may be a little high for Chinese pregnant women with such background of iodine nutrition.

Keywords: Pregnancy, Infants, Urinary iodine concentration, Thyroid function, Physical development

OAB(T3)3-3
Health behavior clusters, temperament and weight status among Finnish preschoolers

Henna Vepsalainen[1], Liisa Korkalo[1], Anna M Abdollahi[1,2], Reetta Lehto[2], Elina Engberg[2], Marja H Leppänen[2], Carola Ray[2], Eva Roos[2,3], Maijaliisa Erkkola[1], on behalf of the DAGIS research group

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Background and objectives: Studies have shown that health behaviors, such as sedentariness and screen time, physical activity (PA), sleep, and food consumption associate with weight status, and these behaviors tend to cluster already at preschool-age. The current study investigated health behavior clusters among 3–6-year-olds and sought to determine whether the clusters associated with sociodemographic factors, temperament dimensions (negative affectivity, surgency, effortful control), and weight status.

Methods: Altogether 864 children were included. We used food records (3–5 days) to measure dietary intake and 7-day sedentary behavior diary to assess screen time and sleep habits. Accelerometers were used to assess PA and sleep duration during 7 days. Temperament dimensions were assessed using the Children's Behavior Questionnaire. Researchers measured the children's weight and height and categorized the participants into normal weight or overweight based on BMI. We used finite mixture models to identify health behavior clusters and Student's t-test and Chi-squared tests to compare sociodemographic factors, temperament dimensions, and weight status between the participants in the health behavior clusters.

Results: We identified two distinct health behavior clusters. Of the participants, 440 (51%) were categorized into the cluster labelled “Unhealthy diet, excessive screen time”, which was characterized by unhealthier dietary choices (i.e. lower use of vegetables and rye bread, higher use of sweets and juice) and higher screen time. The second cluster was labelled “Healthy diet, moderate screen time”. PA and sleep were not decisive in clustering. Compared to the participants in the “Unhealthy diet, excessive screen time” cluster, the participants in the “Healthy diet, moderate screen time” cluster were younger (4.6 y vs. 4.8 y, p=0.001), had lower negative affectivity (3.6 vs. 3.8, p=0.05), and higher educated parents (41% vs. 29% of parents had master's degree, p=0.001). No differences were detected regarding gender, other temperament dimensions, or weight status.

Conclusions: The findings suggest that increasing age, higher negative affectivity and lower parental education associate with less beneficial health behaviors already among 3–6-year-olds. To promote future health, parents need support in maintaining beneficial health behaviors as the child grows. In addition, tailored support acknowledging the child's temperament could be profitable.

Keywords: cluster analysis, lifestyles, whole diet, sedentary behavior, obesity

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Further Collaborators: Co-authors: Essi Skaffari, University of Helsinki; Riikka Pajulahti, University of Helsinki, Folkhälsan Research Center; Elviira Lehto, University of Helsinki

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OAB(T3)3-4

Diet quality during pregnancy and child brain morphology: A prospective population-based study

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Background and objectives: Diet quality during pregnancy has been associated with neurodevelopmental outcomes and cognitive performance in children. However, little is known about the underlying neurobiological mechanisms. We aimed to examine associations of diet quality during pregnancy with pre-adolescent brain morphology, including measures of volumetric and white matter microstructure.

Methods: We included 2249 mother-child dyads from the Generation R Study, a population-based cohort in the Netherlands. Dietary intake during pregnancy was assessed with a 293-item food-frequency questionnaire and pre-defined diet quality scores were calculated including 15 food components (total scores ranging from 0-15), reflecting adherence to national dietary guidelines. Child brain scans were collected using MRI (including diffusion tensor imaging) at the age of 10 years. Structural brain volumes, including total brain, cerebral white matter, cerebral gray matter and subcortical volumes, were extracted by FreeSurfer. White matter microstructure was quantified by global fractional anisotropy and mean diffusivity.

Results: After adjustment for child age, sex, socioeconomic factors, maternal age at enrollment, smoking and psychopathological symptoms during pregnancy in multiple regression models, we found that mothers' higher diet quality was associated with a larger total brain volume (B = 3.52, 95%CI: 0.91, 6.12), cerebral white matter (B = 1.53, 95%CI: 0.26, 2.79) and cerebral gray matter volumes of children at age 10 years (B = 1.75, 95%CI: 0.40, 3.11). All associations remained after multiple testing correction. Furthermore, the association of total brain volume was independent of child diet quality at age eight years. Diet quality during pregnancy was not related to child white matter microstructure at age 10 years.

Conclusions: Our findings from a large population-based setting suggested long-term global effects of diet quality during pregnancy on child brain structural alterations. These findings indicate the importance of dietary intake during pregnancy for children's brain development, which calls for more research and prevention strategies on overall diet during pregnancy.

Keywords: Cohort studies, Epidemiology, Pregnancy, Diet quality, Brain development

Conflict of Interest Disclosure: None

Further Collaborators: N/A

OAB(T3)3-5

Intra-uterine maternal haemoglobin concentration is associated with cognitive function in stunted adolescents: results from a 17-year retrospective cohort study in Indonesia

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Background and objectives: Maternal anaemia is a major public health problem that has a negative impact on the neurodevelopment of children under the age of five, but its impact on long-term cognitive performance is largely unknown. This study aims to investigate the association between intra-uterine maternal haemoglobin (Hb) concentration and cognitive function of their offspring during adolescence.

Methods: We performed secondary analysis on the retrospective cohort data of 363 paired pregnant mothers and their offspring at 10-14 years of age from the Indonesia Family Life Survey (IFLS) conducted in 1997 - 2014. Cognitive function was measured as the total score on the Raven's Progressive Matrices test. Multiple linear regression models with maternal Hb as exposure and cognitive function as outcome were explored, with adjustments for maternal age, maternal height, and socioeconomic status.

Results: The weighted anaemia prevalence was 49.3% in pregnant mothers and 22.2% in adolescents. The mean total cognitive score of adolescents was 12.4 out of 17. Adolescents who were stunted, anaemic, and living in a rural area had a significantly lower cognitive score than their counterparts. In the adjusted model, maternal Hb was not associated with adolescent cognitive function (β: 0.14; 95%CI: -0.05 – 0.34). However, the effect of maternal Hb level on cognitive function of their offspring was modified by stunting status (stunted β: 0.44; 95%CI: 0.05 – 0.82 and non-stunted β: 0.01; 95%CI: -0.02 – 0.24).

Conclusions: For each 1 g/dL increase in Hb, cognitive scores increased by 0.44, but only in stunted adolescents. This study shows that adverse cognitive outcomes at adolescent age is likely multi-causal and can best be addressed by tackling pregnancy-related anaemia as well as warranting good nutrition for growth and development during childhood.

Keywords: Pregnancy, maternal haemoglobin, adolescents, cognitive function, Indonesia

OAB(T3)3-6

Symptoms of depression among Mexican adolescent girls in relation to iron status, anemia, body weight, and gut microbiota composition: results from a Latent Class Analysis

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Background and objective: Depression is a common problem among adolescents. Previous observational research reported an association between nutritional status and gut microbiota composition with depression. This study examined the association between symptoms of depression and iron status, anemia, body weight, and gut microbiota composition among Mexican adolescent girls.

Methods: In this cross-sectional study, we collected data from 408 girls aged 12-20 years. Depressive symptoms were assessed by the 6-item Kutcher Adolescent Depressive Scale, and latent class analysis (LCA) was used to identify and characterize distinct groups of girls based on symptoms of depression. Iron status and inflammation were assessed using ferritin and soluble transferrin receptor, C-reactive protein and alpha-1-acid glycoprotein. Multiple logistic and linear regression were applied to model class membership as a function of iron status, anemia, and body weight. Fecal samples were collected from a subsample of 139 girls. The relative quantification of bacterial taxa was done using 16S ribosomal RNA gene amplicon sequencing.

Results: LCA yielded three classes of symptoms of depression; 44.4% of the adolescents were “unlikely to be depressed”, 41.5% were “likely to be depressed”, and 14.1% were “highly likely to be depressed”. Our analyses demonstrated that iron deficient girls had greater odds of being “likely depressed” (odds ratio, OR=2.01, 95% CI 1.01-3.00) or “highly likely depressed (OR=2.80, 95% CI 1.76-3.84). Linear regression analyses revealed that lower hemoglobin concentrations and higher body weight increased the probability of being “likely depressed”. Beta-diversity revealed no differences in bacterial composition between participants within the different classes of symptoms of depression. Phyla and genera were not shown to be different between classes of depression. However, variables of iron and inflammatory status, that may be associated with depression seemed to explain some of the variation in beta diversity.

Conclusion: This study showed that iron deficient adolescent girls were more likely to suffer from symptoms of depression, and that lower concentrations of hemoglobin and higher body weight increased the probability of experiencing symptoms of depression. No differences in microbiota composition were observed across the three classes of symptoms of depression. However, and the findings suggest a potential link between iron metabolism, inflammation, and depression.

Keywords: depression, adolescence , iron deficiency, anemia, gut microbiota

Conflict of Interest Disclosure: We declare no conflict of interest

OAB(T3)2-2

Women's empowerment, childhood nutritional outcomes and the mediating role of household headship structure: Evidence from sub-Saharan Africa

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Background and objectives: Women's empowerment influences childhood nutrition through different complex mechanisms. In this study, we aimed to determine the association of women's empowerment with anemia, stunting, and their co-occurrence among children aged 6–59 months while accounting for the mediating role of household headship structure. **Methods**: Data on 25,665 woman-child dyads from the most recent Demographic and Health Survey (2015–2018) from eight sub-Saharan African countries were analyzed. Childhood anemia (hemoglobin concentration <110 g/L) and stunting (height-for-age z score <-2) were calculated. Women's empowerment was measured as a composite index of participation in household decision making, attitude towards domestic violence, and assets ownership. **Results**: Applying the Lewbel 2-stage least squares method with migration as an instrument variable, an increase in women's empowerment index reduces their child's likelihood of being anemic and the co-occurrence of anemia and stunting (Coeff (SE); -0.114 (0.025) and -0.072 (0.032), respectively). Specifically, asset ownership and decision-making dimensions of empowerment significantly reduce anaemia and, the co-occurrence of anemia and stunting among children. Migrant women were more empowered than non-migrant women. Children of empowered women belonging to male-headed households were more likely to be anemic and, be anemic and stunted concurrently compared to their counterparts whose mothers belonged to female-headed households (0.031 (0.008). **Conclusion**: Interventions designed to improve childhood nutrition through women's empowerment approaches need to be hinged on asset and instrumental agency of women and acknowledge the mediating effect of household headship typology.

Keywords: Women's empowerment, Household headship, Migration, Anemia, Stunting

Conflict of Interest Disclosure: NONE

Further Collaborators: NONE

OAB(T3)2-3

Perceived Food Environments and Household Dynamics related to nutrition among Mother and Grandparents of Young Children in Cambodia

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Background and objectives: Food environments may influence the nutrition transition in Cambodia. Along with the nutrition transition, food environments have also changed with development over time. Dietary choices and snack consumption data among children and mothers in Cambodia are limited. However, the trends of snack consumption observed among young children and the mother's weight status urge further investigation of food environments, food sources and household dynamics. The objective was to understand mothers' and grandparents on their perceptions of food environments and household dynamics around nutrition.

Methods: The study emerges from a larger study using a mixed-method approach, while this only study focuses on the qualitative focus group discussion (FDG). The study was conducted in Phnom Penh (*n*=1 grandparents), Kampot (*n*=4 parents and *n*=3 grandparents) and Kampong Thom province (*n*=4 parents and *n*=3 grandparents).

Results: The FGD participants generally mapped their food sources to come from 1) Nature, fields, forests, rivers, 2) Own fields, gardens, or livestock, 3) Neighbour and friends, 4) Village farmers, 5) Shops, 6) Mobile vendors, and 7) street vendors. The options allow households to balance dietary diversity requirements against an often-limited financial capacity and distance to alternatives. Neighbourhood relations facilitate a food-type arrangement for trade and sharing. Nutritious foods are generally sourced from the first four source categories. By comparison, snacks, processed foods, and desserts are among the last three, although nutritious options are also found here. Mothers are the primary caregiver and grandmothers when the mother is unavailable due to work commitments. Other family members may also provide support (father, aunt, uncle, grandfather, or siblings). The mother and grandmother make the decisions on food in the household. The father may have a say on occasion concerning food preference. Mothers and grandmothers determine where food is sourced, money spent, the type of food purchased, and who cooks the food.

Conclusions: Most healthy and diverse foods are sourced from nature, own production, or village farmers, while mothers and grandmothers are the primary ones responsible for childcare and decision-makers for food consumed by the whole family and hence deciding most nutritional intake in the family.

Keywords: Nutrition transformation, Food environment, Women of Reproductive Age, Children, Cambodia

Conflict of Interest Disclosure: The authors declare no conflicts of interest

OAB(T3)2-4

The Importance of Gender Equality in Addressing Adolescent Malnutrition in Bangladesh

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Background and objectives: Adolescent girls in Bangladesh face threats to their nutritional wellbeing and human rights, including gender-based violence, gender-based food taboos and early marriage. Nationally, 48.6% of girls (15-19 years) have anaemia. Less than half of Bangladeshi females (10-49 years) have access to an adequately diverse diet and adolescent girls are at least twice as likely as boys to go to sleep hungry, skip meals, and take smaller meals (GAIN-2018).

Methods: Enhancing Nutrition Services to Improve Maternal and Child Health (ENRICH) project, funded by Global Affairs Canada, aimed to reduce malnutrition in the first 1000 days through nutrition-specific and nutrition-sensitive interventions. To address the gender inequalities that contribute to poor nutrition among adolescent girls, ENRICH created Adolescent Girl Power Groups (AGPGs). AGPGs provided life/livelihood skills for a meaningful/sustainable contribution to girls' nutrition and promoted micronutrient supplementation, gender-equal food production/consumption practices, eradication of early marriages, economic empowerment, and greater participation of girls' decision-making related to nutrition.

Results: AGPGs contributed to improved knowledge/self-confidence and changes in girls' power/decision-making. Most girls reported they had sufficient information to make important nutrition decisions and had more control over decisions related to diet, with 87% stating that they make their own decisions about what/when or how much they eat. Furthermore, 99% of girls stated they currently did not have any dietary restrictions not of their own volition. Recent endline results confirmed positive shifts in household gender norms with improvements in equitable decision-making for working/earning income, contraception use, health-seeking behaviors, and spending money on food. Health facility assessments revealed increases in gender sensitivity training and gender equality policies, fostering a supportive environment for girls to claim their nutrition rights.

Conclusions: The AGPG approach empowered adolescent girls to claim their nutrition-related rights and act as change agents in their families/communities. The AGPG model shows the transformative power of an empowerment approach and ultimately demonstrates that progress towards improved nutrition outcomes is possible when girls exercise agency over strategic life decisions, have access to and control over resources, and experience the informal and formal structures around them as enabling their opportunity to improve their rights to good nutrition.

Keywords: Adolescent Nutrition, Gender Equality, Anaemia, Malnutrition, Diet Diversity

OAB(T3)2-5

Revisiting hydration and density of fat-free mass in Indian children and adolescents using 4-compartment model: Implications for estimation of body composition using 2-compartment models

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Background and objectives: As the burden of childhood overweight/obesity increases, accurate methods are needed to evaluate body composition. Hydrometry and densitometry are commonly used 2-compartment (2C) models to assess paediatric body composition. The accuracy of 2C models in estimating body fat depends on the validity of literature reported constants for hydration (HF) and density of fat-free mass (D_{FFM}). Empirical data on these constants, particularly in South Asian children/adolescents with postulated thin-fat phenotype, are lacking. The objectives were 1) to derive prediction equations for HF and D_{FFM} using 4C model in children/adolescents from South India, 2) to test the validity of the equations to estimate percent fat mass (%FM) using 2C models, compared to 4C model.

Methods: The cross-sectional study included 300 children/adolescents (45% male), aged between 6-15y from Bengaluru, India. Total body water, bone mineral content and body volume were measured using deuterium dilution, dual energy X-ray absorptiometry and air displacement plethysmography, respectively to obtain HF, D_{FFM} and %FM (using 2C and 4C models). Multiple linear regression models were used to derive prediction equations for HF and D_{FFM} in a randomly selected testing sample (n=150). Agreement between %FM obtained from 2C models (using predicted constants from regression equation) and 4C model were evaluated in a validation sample (n=150).

Results: The prevalence of underweight and overweight/obesity were 5% and 17%. The mean (±SD) HF and D_{FFM} were 72.6±2.5% and 1099.9±8.7 g/mL, respectively. The significant predictors for HF were sex and BMI-for-age-z-scores (BAZ), while for D_{FFM} were age, sex and BAZ. The prediction equation for HF% was 71.542+(0.379×BAZ) + (3.019×Male sex), [R^2=0.38, SEE=2.04%], and for D_{FFM} g/mL was 1095.7+(0.711×Age) +(-1.256×BAZ) + (-10.276×Male sex), [R^2=0.41, SEE=6.98 g/mL]. The mean bias of %FM from hydrometry and densitometry using the literature reported HF and D_{FFM} were -3.6±2.9% (p<0.001) and 5.4±3.3% (p<0.001) against 4C estimates, which reduced to -0.45±2.0% (p<0.01) and 0.49±2.2% (p<0.01) using the predicted constants.

Conclusions: Previously published HF and D_{FFM} could induce errors in %FM estimates in Indian children/adolescents, possibly due to the ethnic/phenotypic differences. The equations derived in the present study provided reliable estimates of %FM using hydrometry and densitometry models; however, needs to be confirmed in larger sample.

Keywords: Density of fat-free mass, Hydration of fat-free mass, Densitometry, Hydrometry, Paediatric body composition

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T3)2-6

Sustained effects of small-quantity lipid-based nutrient supplements provided during the first 1000 days on child growth at 9-11 years in a randomized controlled trial in Ghana

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Background and Objective: There is limited research on the impact of nutritional supplementation in the first 1000 days on long-term child growth. We aimed to investigate the effects of pre- and post-natal small-quantity lipid-based nutrient supplements (SQ-LNS) on child growth at age 9-11 years.

Methods: The International Lipid-Based Nutrient Supplements (iLiNS) DYAD-Ghana trial was a randomized controlled trial conducted in 2009-2014. 1320 pregnant women ≦ 20 weeks gestation were randomly assigned to receive daily (1) iron and folic acid during pregnancy and placebo during 6 months postpartum, (2) multiple micronutrients (18) during pregnancy and 6 months postpartum, or (3) SQ-LNS (20 g/d) for pregnant women during pregnancy and 6 months postpartum and SQ-LNS for children from 6 to 18 months of age. In 2021, we assessed child growth at age 9-11 years using height-for-age z-score (HAZ), BMI-for-age, waist -to-height ratio, triceps skinfold and mid-upper arm circumference. Models were adjusted for child's age at measurement.

Results: We re-enrolled and assessed outcomes in 966 children. LNS children had a marginally higher HAZ (p=0.060) than non-LNS children [mean (SD) of −0.04 (0.96) vs −0.16 (0.99)]. There were no other group differences. For child HAZ, there was an interaction with child sex (p-interaction = 0.075) and maternal pre-pregnancy BMI (kg/m^2) (p-interaction = 0.002). Among females, HAZ was higher in the LNS [0.08 (0.07)] than non-LNS [-0.16 (0.05)] group (p = 0.010); among males, the LNS [-0.16 (0.08)] and non-LNS, [-0.16 (0.06)] groups did not differ (p=0.974). Among women with BMI <25, HAZ was higher in the LNS [-0.04 (1.00)] than non-LNS [-0.30 (0.94)] group (p = 0.003);

among women with BMI ≧ 25, the LNS (-0.03 (0.90 SD)) and non-LNS, (0.07 (1.02 SD)) groups did not differ (p=0.321).

Conclusions: Children who received pre- and post-natal SQ-LNS tended to have higher HAZ overall than non-LNS children. In exploratory effect modification testing, SQ-LNS positively affected HAZ among female children and children of non-overweight/obese women. LNS did not increase BMI-for-age. This sustained impact of LNS suggests it may be a useful tool for improving long-term child growth.

Keywords: lipid-based nutrient supplements, growth, middle childhood, 1000 days, Ghana

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OAB(T3)4-1
Circadian rhythm during pregnancy and its association with infant growth in the first 6 months of life: results from MY-CARE cohort study

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Background & Objectives: Circadian rhythm refers to the internal 24h clock that synchronizes behavioral and physiological activities to the time of the day. Disruption or misalignment of circadian rhythm during pregnancy has been associated with adverse maternal and birth outcomes. However, less is known about the role of maternal circadian rhythm on infant growth in healthy pregnancies.

Methods: This prospective cohort study aimed to determine circadian rhythm during pregnancy and its effect on infant growth in the first 6 months of life among 70 healthy primigravidas. All primigravidas provided salivary samples at 5 time-points over a 24h day for melatonin and cortisol assay. Circadian parameters of melatonin and cortisol rhythm including mean, amplitude, area under the curve (AUC), peak melatonin, awakening cortisol level, and diurnal cortisol slope were examined. Infant's anthropometric data at 1, 3, and 6 months was collected from clinic records.

Results: Pregnant women in this study displayed a rhythmic profile of melatonin and cortisol secretions that were largely maintained across trimesters. Salivary melatonin rhythm was characterized by a gradual increment towards the night, reaching the peak at the middle of the night and declining from the morning. In contrast, salivary cortisol rhythm was characterized by a maximal cortisol level in the morning, followed by a steep decline over the day. As the pregnancy progressed, the overall melatonin levels remained stable whereas cortisol levels were increased by 1.4-fold. Reduced mean melatonin level across trimesters was associated with a lower infant LAZ (β=1.79, p=0.012) but a higher infant WLZ (β=-1.74, p=0.030) in the first 6 months, suggesting that reduced melatonin output had a more significant influence on infant's linear growth. Additionally, increased melatonin peak (β=-0.37, p=0.027), melatonin AUCG (β=-0.38, p=0.034), and reduced awakening cortisol level (β=-1.74, p=0.030) across trimesters were associated with a lower infant head circumference growth in the first six months.

Conclusions: Findings show that altered maternal circadian rhythm, as measured by melatonin and cortisol, during pregnancy has a programming role on infant's linear growth and brain development in the first six months. This suggests the potential of circadian-based intervention targeting maternal circadian rhythm to promote optimal infant growth.

Keywords: Circadian rhythm, pregnancy, infant growth, melatonin, cortisol

OAB(T3)4-2
Nutrition o'clock: The role of chrononutrition on maternal cortisol rhythm and pregnancy outcomes

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Background and objectives: Chrononutrition is an emerging, modifiable approach to metabolic health and weight management. Understanding the role of chrononutrition during pregnancy provides new insights into dietary-based preventive approaches for optimal pregnancy outcomes. This prospective cohort study aimed to determine chrononutrition pattern during pregnancy and its association with maternal cortisol rhythm and pregnancy outcomes among 123 healthy primigravidas.

Methods: During their second and third trimester, women completed a 3-day food record. Subsamples provided salivary sampling at 5 time-points over a 24h day for cortisol assay. Data on pregnancy outcomes were collected from clinic records.

Results: In this study, the prevalence of low birth weight and preterm birth was 12.3% and 9.8%, respectively. A total of 28.9% and 38.0% of women had inadequate or excessive gestational weight gain (GWG), respectively. Pregnant women displayed a rhythmic diurnal cortisol decline with the mean level elevated by 1.4-fold as pregnancy advanced. Breakfast skippers displayed a lower awakening cortisol level in the second and third trimester (β=-0.38, p=0.012 and β=-0.31, p=0.038, respectively). Reduced

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

or steeper morning and evening cortisol slopes following higher energy intake were observed. At the macronutrient level, temporal protein and fat intakes in the earlier times of the day (at 7:00-11:59h, 12:00-15:59h, and 16:00-18:59h) were associated with an altered mean level and amplitude of cortisol rhythm. In terms of pregnancy outcomes, late-night eating in the second trimester was associated with a longer gestation length (B=0.66, p=0.014). Women with a longer eating window during the third trimester had a lower birth weight infants (B=-0.25, p=0.024). In the second trimester, higher energy and carbohydrate intake in the morning during 7:00-11:59h (B=0.06, p=0.044 and B=0.11, p=0.030) predicted a higher risk of excessive GWG. Conversely, lower energy intake during 19:00-23:59h (B=-0.07, p=0.031) in the third trimester was associated with a higher risk of excessive GWG. **Conclusions:** Findings point to the role of maternal chrononutrition on circadian cortisol rhythmicity and pregnancy outcome disparities in healthy pregnancies. Incorporating chrononutrition aspects in dietary intervention for optimal GWG and birth outcomes can be considered.

Keywords: Chrononutrition, Pregnancy, Cortisol, Birth outcomes, Circadian rhythm

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OAB(T3)4-3

Adherence to plant based diets in pregnancy in its association with birth outcomes and pregnancy complications in the Danish National Birth Cohort.

Thorhallur Ingi Halldorsson[1,3], Signe Hedgaard[2], Anne Ahrendt Bjergaard[3], Sjurdur F Olsen[3], Kristina M Renault[2]

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Background and Objectives: Due to increased environmental concerns and awareness, plant-based diets with limited (e.g. lacto-ovo- and pesco-pollo-vegetarians) or no (e.g. vegans) consumption of foods of animal origin have become increasingly popularity. Although such diets have many nutritional benefits the strictest forms may pose nutritional challenges, particularly during vulnerable life stages such as pregnancy. The aim of this study was to examine associations between adherence of different plant-based diets in pregnancy in relation to measures of fetal growth and pregnancy complications.

Methods: A sample of 66,739 women form the Danish National Birth Cohort who were recruited between 1996 to 2002. All women filled out a comprehensive food frequency questionnaire in mid-pregnancy, which included questions on adherence to plant-based diet. Information on birth outcomes and pregnancy complications were extracted form National Registries.

Results: Out of 66,739 women included in the study 666, 183 and 18 defined themselves as pesco-pollo-vegetarians, lacto-ovo-vegetarians or vegans in mid-pregnancy, respectively. No major differences in macro and micronutrients composition were observed between non-vegetarians and those defining themselves as pesco-pollo-vegetarian. Mean protein intake, as % of energy (%E) was, however, somewhat lower among lacto-ovo-vegitarians(13.3 %E) and more so by those defning themselves as vegans (10.4 %E) compared non-vegetarians (15.0 %E). Similar contrasts were also observed for some other nutrients including calcium and vitamin B12. In terms of birth outcomes, those defining themselves as vegans had on average -221 gram (95% confidence interval: -436, -6) lower birth weight compared to those not adhearing to vegetarian diets. The prevalence of low birth weight (<2500g) and preeclampsia was also significantly higher among vegans compared to non-vegetarian diets. No significant differences were observed for the other diets.

Conclusions: Our results, although based on small numbers, suggests that adhering to strict vegan diets may result in lower birth weight and increased prevalence of pregnancy complication. No differences in birth outcomes or pregnancy complications were observed for less strict vegetarian diets.

Keywords: Vegetarian, Vegan, Plant based diets, pregnancy, birth weight

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OAB(T3)4-4

Adherence to plant based diets in pregnancy in its association with birth outcomes and pregnancy complications in the Danish National Birth Cohort.

Thorhallur Ingi Halldorsson[1,3], Signe Hedgaard[2], Anne Ahrendt Bjergaard[3], Sjurdur F Olsen[3], Kristina M Renault[2]

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Background and Objectives: Due to increased environmental concerns and awareness, plant-based diets with limited (e.g. lacto-ovo- and pesco-pollo-vegetarians) or no (e.g. vegans) consumption of foods of animal origin have become increasingly popularity. Although such diets have many nutritional benefits the strictest forms may pose nutritional challenges, particularly during vulnerable life stages such as pregnancy. The aim of this study was to examine associations between adherence of different plant-based diets in pregnancy in relation to measures of fetal growth and pregnancy complications.

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Conclusions: Our results, although based on small numbers, suggests that adhering to strict vegan diets may result in lower birth weight and increased prevalence of pregnancy complication. No differences in birth outcomes or pregnancy complications were observed for less strict vegetarian diets.

Keywords: Vegetarian, Vegan, Plant based diets, pregnancy, birth weight

OAB(T3)4-5

M–SAKHI Mobile health solutions to help community providers promote maternal and infant nutrition and health using a community–based cluster randomized controlled trial in rural India

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Background and objectives: Interventions that focus only on improving infant nutrition have had limited success in reducing stunting. We developed a mobile phone-based pregnancy and child-care behaviour change communication intervention, M–SAKHI. We introduced it in villages in Central India for pregnant women until their infants were 12 months. The trial's primary objective was to reduce under-five child stunting (height–for–age <-2 z-score) in intervention compared to control.

Methods: Using a cluster randomised controlled trial, we allocated 40 clusters (244 villages, 2501 pregnant women; 1296 in control and 1250 in intervention) to Usual MCH Care or M–SAKHI with Usual Care. The M–SAKHI intervention provided weekly voice messages, text messages, and counselling calls. Also, we held monthly face-to-face meetings with trained community health workers who collected real-time data that triggered client-specific messages, provided counselling, and played health videos and voice messages embedded in the M–SAKHI App. An independent team of trained interviewers and anthropometrists collected the outcome data monthly with special-purpose data capture programs on android tablets. In an intention to treat analysis, we estimated relative risk (RR) and 95% confidence intervals by fitting a multilevel mixed-effect generalised linear model using Poisson regression. We prospectively registered the trial with number: CTRI/2018/02/011915

Results: We recruited 1251 and 1250 women in usual care and M–SAKHI arms, respectively, resulting in 1180 and 1171 livebirths, of which 1125 and 1136 were available at the 18-month outcome evaluation. Over the 18 month follow-up, we evaluated 7,351 and 7,445 anthropometric measurements in control and intervention arms. There was a 10% reduction in the risk of stunting (RR0.90, 95%CI0.75–1.07) but with a significant interaction by age (p=0.004). We found a significant reduction in stunting at 10–month (RR0.73, 95%CI0.59–0.90, absolute reduction 15.8% to 11.7%) and 12–month (RR0.80, 95%CI 0.66–0.97 absolute reduction 19.1% to 14.9%) visits. During the 12 months we delivered the intervention, there was a 24% reduction in stunting risk (RR0.76, 95%CI0.63–0.92) but no effect afterwards.

Conclusions: The M–SAKHI intervention reduced child stunting while delivered, but the effect was not sustained once the communications program ceased.

Keywords: Behaviour change communications, infant growth, Child stunting, mHealth, Mobile phone communications

OAB(T3)4-6

Neurodevelopment scores are associated with multiple components of nurturing care in the 24 month old offspring of participants in the multi-country "Women First" preconception maternal nutrition trial

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Background and Objectives: Neurodevelopment in young children in low resource settings is optimized by components of both physical health and nurturing environments. The impact of a 3-arm maternal nutrition intervention delivered from preconception or 12 wk gestation (or none) through to delivery was assessed along with post-natal growth and nurturing care indicators on the Bayley Scales of Infant Development-III (BSID) at 24 mo in offspring of participants in the four LMIC countries in the Women First (WF) trial.

Methods: Anthropometry measurements were obtained at birth and 6-mo intervals thereafter; BSID and Family Care Indicators (FCI) were completed at 24 mo in a random sub-set of the WF offspring, representing 2/3 of infants with valid birth measurements. Multiple covariates (intervention arm, site, cluster within site, maternal education, age, SES, FCI subscales, LBW, and anthropometry Z-scores at 6 mo and change (D) from 6 to 24 mo, e.g. length-for-age, D-$LAZ_{6\text{-}24}$) were considered as predictors and were adjusted for in a general linear model to predict adjusted mean differences (AMD) in scores of cognitive(C), motor(M), and social-emotional (SE) subscales of the BSID.

Results: 1,386 infants (93% of sub-set randomized for BSID assessment, approximately equal across 3 arms) were included in the analysis. Differences in BSID subscales associated with intervention arm were significant in only one site. Maternal education, FCI play materials, and WAZ at 6 mo were predictive of all 24-month BSID subscale scores. Four covariates positively associated ($p <= 0.01$) with all subscales were: maternal secondary education (AMD 3.6(C), 3.35(M), 2.8(SE)); D-$LAZ_{6\text{-}24}$ (AMD 1.98(C), 3.15(M), 2.06(SE)); BW>2500 g (AMD 1.64(C), 2.20(M), 2.31(SE)); and FCI play materials (AMD 1.46(C), 1.36(M), 1.72(SE)). No other anthropometric or maternal variables were consistently associated with any BSID subscales across all sites.

Conclusion: These findings underscore the multiple critical components of nurturing care for early child development, including the caregiver, adequate birth weight, healthy linear growth, and opportunities for learning. Results also suggest that the positive effects of maternal nutrition supplementation started before and or in early pregnancy on birth length and postnatal linear growth may have enduring downstream benefits for children's neurodevelopment.

Keywords: Neurodevelopment, Nurturing Care, Preconception Nutrition, Growth

Conflict of Interest Disclosure: All authors have indicated no conflict of interest.

Further Collaborators: *Women First Preconception Maternal Nutrition Study Group as follows:

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OAB(T3)4-7
Comprehensive behavioral analyses of male and female mice derived from mothers fed a diet high in omega-6 and low in omega-3 fatty acids

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Background and objectives: Most animals cannot synthesize omega-6 (n-6) or omega-3 (n-3) polyunsaturated fatty acids (PUFAs), which are essential nutrients for normal brain development and function. These PUFAs are generally competitive in various metabolic processes, and the n-6/n-3 ratio of PUFAs that compose our body warrants particular attention. Regarding recent nutritional trends leading to foods that are high in n-6 PUFAs and low in n-3 PUFAs, we previously reported that intake of an n-6-high/n-3-low diet by pregnant mice induces offspring's enhanced anxiety-related behaviors and hedonic feeding behaviors in adulthood, although the offspring were raised on a well-balanced control diet after birth. This study aims to comprehensively understand the behavioral consequences of the offspring exposed to the n-6-high/n-3-low diet in utero.

Methods: Female wild-type mice were fed either the well-balanced control diet or the n-6-high/n-3-low diet, and the mice were mated and maintained on their respective diet through gestation. At the day of birth, the lactating mothers were exposed to a standard lab chow by replacing the control diet or the n-6-high/n-3-low diet. Offspring after weaning were continued to feed the lab chow. Male and female offspring in adulthood were subjected to a comprehensive behavioral test battery including the open field test, elevated plus-maze test, social interaction test, three-chamber social approach test, rotarod test, Porsolt forced swim test, and several learning tests. The offspring's brain fatty acids were also investigated.

Results: We newly identified significant behavioral differences between the two dietary groups; both male and female offspring exposed to the n-6-high/n-3-low diet in utero showed a decreased social behavior and an impairment in pattern separation, and female offspring exposed to the n-6-high/n-3-low diet in utero showed hyperactivity, compared to those exposed to the control diet in utero. We also confirmed that the brain n-6 and n-3 PUFAs, especially arachidonic acid and docosahexaenoic acid, were increased and decreased, respectively, in the embryos exposed to the n-6-high/n-3-low diet in utero compared to those exposed to the control diet in utero.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: Our findings show that maternal intake of PUFAs during pregnancy can have long-lasting effects on offspring's various behaviors in adulthood.

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Keywords: polyunsaturated fatty acid, brain, comprehensive behavioral test battery, maternal diet, pregnancy

OAB(T3)4-8
Thyroid Volume and Nodules in Iodine-Sufficient Pregnant Women

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Background and objective: Few studies about risk factor of thyroid goiter and TNs were conducted in iodine-sufficient regions. The study aimed to evaluate the iodine nutrition and the potential risk factors of thyroid goiter and nodules in Chinese pregnant women living in an adequate iodine city.

Methods: From April 2015 to May 2017, a total of 2002 pregnant women from Tianjin provinces in China were recruited, thyroid volume (TV) and nodules (TNs), urinary iodine concentration (UIC) and thyroid function were measured.

Results: The median UIC was 158 (106-230) μg/L and 45.5% of pregnant women had a UIC lower than 150 μg/L. TV increased during pregnancy (P<0.001). Increment in TV was found in pregnant women with higher body mass index (BMI), thyroid stimulating hormone (TSH), thyroglobulin (Tg) and positive thyroid peroxidase antibody (TPOAb) and thyroglobulin antibody (TgAb). TV was positively correlated with BMI and negatively related with TSH. Total thyroid goiter rate (TGR) and thyroid nodules rate (TNR) were 1.6% and 11.7%, respectively. Logistic regression analysis showed that BMI ranged from 24-27.9 and >28.0 kg/m^2, Tg> 40μg/L and positive TgAb increased the risk of TG (odds ratio, OR=3.79, 3.88, 5.41 and 4.69, respectively). >30 years old and Tg>40μg/L were independent risk factors of TNs (OR=1.43 and 2.40, respectively).

Conclusions: BMI (>24.0 kg/m^2), Tg (>40μg/L) and positive TgAb may increase the risk of thyroid goiter, and age (>30 years old) and Tg (>40μg/L) were related to high risk of TNs. Continuous monitoring of iodine nutrition during pregnancy should be strengthen, especially in pregnant women with subtle thyroid dysfunction, even in iodine-sufficient regions.

Keywords: Pregnant women, Iodine nutrition, Thyroid goiter, Thyroglobulin, Urinary iodine

OAB(T3)5-1
Strengthening nutrition interventions in antenatal care services improved consumption of iron-folic acid supplements and early breastfeeding practices in Burkina Faso

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Background and objectives: Routine antenatal care (ANC) offers opportunities to receive a broad range of services including support for adequate nutritional care for pregnant women and their newborns. Alive & Thrive (A&T) aimed to strengthen provision of iron-folic acid (IFA) supplementation and interpersonal counseling on maternal nutrition and breastfeeding through government ANC services and community-based contacts in two regions in Burkina Faso. We assessed the impacts of intensified nutrition interventions during ANC (A&T) and standard ANC services (control) on intervention coverage and maternal nutrition practices.

Methods: A cluster-randomized design compared 40 health center catchment areas in A&T areas to 40 in control areas. Repeated cross-sectional surveys in 2019 and 2021 (960 pregnant women and 1920 women with children 0-5 months of age per survey round) provided data on impact indicators and intervention exposure. We derived difference-in-difference effect estimates (DID), adjusted for geographical clustering, for maternal dietary diversity, IFA consumption, and early breastfeeding practices.

Results: More women in A&T areas had 4+ ANC visits (DID: 8.5 percentage points [pp]) and 4+ community-based contacts during their last pregnancy (DID: 14.7 pp) and started ANC during the first trimester (DID: 11.3 pp), compared to control areas. A larger improvement in exposure to nutrition counseling during ANC was achieved in A&T areas than in control areas (DID: 39.5 pp). Women in A&T areas consumed more IFA supplements during pregnancy than in control areas (DID: 21 tablets). Both early initiation of breastfeeding and exclusive breastfeeding also improved (DID: 17.1 pp and 8.3 pp, respectively). However, dietary diversity (4 out of 10 food groups) and mean probability of adequacy of micronutrients intake (14%) among pregnant women remained low in both areas.

Conclusions: Strengthening maternal nutrition interventions delivered through government ANC services was feasible and effective in improving maternal nutrition practices, despite implementation during the COVID-19 pandemic. Continued efforts to strengthen the delivery and use of maternal nutrition services may be required for greater behavior changes, as well as to address family support, social norms, and other factors to improve maternal diet.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: Authors have no conflicts of interest.

Keywords: antenatal care, breastfeeding, iron-folic acid supplementation, maternal nutrition, Burkina Faso

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OAB(T3)5-2
Impact of Behaviour Change Comunication Intervention on Responsive Feeding Practices of Caregivers of Infants and Young Children, 6-23 months in Ghana

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Background and objectives: The World Health Organisation's Complementary Feeding (CF) guidelines include the application of psychosocial care during feeding, known as Responsive Feeding (RF). RF emphasises feeding infants directly and assisting older children when they feed themselves, being sensitive to their hunger and satiety cues, feeding slowly and patiently, encouraging children to eat, but not forcing them. We investigated the factors associated with RF practices, and impact of BCC focused on appropriate CF, on RF and Feeding During Illness and Recovery (FDIR) Practices of caregivers of infants, 6-23 months in Bosomtwe District, Ashanti Region, Ghana.

Methods: We recruited 525 mother-infant pairs at baseline; 322(61.3%) received BCC, while 203 (38.6%) served as controls. Education, counselling and demonstrations on appropriate CF according to WHO's guidelines were provided for six months to the BCC group, but not the controls. Structured questionnaires were used to collect data on RF and FDIR practices before and after the BCC intervention. Crude models, Mann-Whitney U tests and paired sample T-tests were used for statistical analysis of the data.

Results: Mean age of the caregivers at baseline was 29.3 years, and 11.4 months for their children. Children age and gender in intervention versus controls were similar at baseline. Only 6.3% of caregivers practised good RF and just 3% practiced good FDIR, baseline, and caregivers' socio-demographic characteristics were not associated with RF and FDIR practices. Caregivers', with poor RF practices at baseline had lower odds for good FDIR (OR= 0.03, p< 0.001, 95%CI=0.01-0.1). Also at baseline, similar proportions of caregivers in BCC (94.4%) and controls (92.6%) practiced poor RF (chi square 0.7, p=0.408), but these reduced significantly post intervention in the BCC (40.2%) group, and only marginally in the controls (86.8%, p<0.001). Likewise, more BCC receiving caregivers had good FDIR post intervention than the controls. Contrary to baseline observations, whereby the BCC group had increased odds for poor RF (OR= 1.3, p<=0.410, 95%CI=0.7-2.7), post intervention, caregivers in the BCC group had reduced odds for poor RF (OR= 0.1, p<0.001, 95%CI= 0.01-0.1).

Conclusions: BCC on appropriate CF following to WHO's guidelines improved RF and FDIR practices among caregivers of infants and young children in Ashanti Region, Ghana.

Keywords: Behaviour Change Communication, Responsive Feeding, Feeding During Illness and Recovery, Complementary Feeding

Conflict of Interest Disclosure: No Conflict of Interest

OAB(T3)5-3
The association of maternal diet and breast milk fatty acid composition

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Background and objectives: Exclusive breastfeeding during the first six months after birth provides the infant with the most optimal start for life. Maternal diet is suggested to influence the composition of breast milk. However, little is known about the exact impact on nutrient level. Breast milk fatty acid content has been studied most in this context, therefore, this review aims to summarize the evidence on the role of maternal diet in breast milk fatty acid composition.

Methods: A systematic PubMed search was carried out, limited to articles published between January 2015 and March 2021, based on the latest inclusion date of the earlier review on this topic of Bravi et al., 2016. Studies were included if they provided quantitative information and were conducted among apparently healthy mothers, of healthy term infants. This review combines the latest results published and those articles identified by Bravi and colleagues.

Results: In total, 17 new publications were identified and combined with 12 studies described by Bravi et al. Among all fatty acids, PUFAs were studied most, by far. Maternal fish intake was predominantly significantly positively associated with breast milk ALA (r= 0.28 – 0.42), DHA (r= 0.24 – 0.46) and EPA (r= 0.25 – 0.28) content. Interestingly, seafood consumption showed mainly negative significant associations, for example with breast milk LA (r= -0.28 – -0.32), DPA (r= -0.32 – -0.51) and total PUFA (r= -0.26 – -0.31). Both, maternal DHA and EPA intake were significantly positively correlated with breast milk DHA content. ALA, EPA, total PUFA, n-3 PUFA, n-6 PUFA and SFA in breast milk were often positively associated with maternal dietary intake. Negative correlations were observed for maternal SFA intake and several fatty acids in breast milk.

Conclusions: There are convincing indications that maternal diet is associated with breast milk fatty acid content, especially for fish intake and DHA concentrations. Yet, for most fatty acids in breast milk, it remains difficult to draw conclusions due to differences in study quality and large diversity in assessed exposure and outcome combinations. More high-quality studies assessing maternal diet and breast milk composition are needed, with strict sampling protocols and appropriate sample sizes.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Breast milk composition, Maternal diet, Fatty acids

Conflict of Interest Disclosure: All authors stated no conflict of interest. This study was performed as part of PhD studies, funded by Ausnutria B.V.

OAB(T3)5-4

High consumption of unhealthy commercial foods and beverages tracks across the complementary feeding period among young children in rural/peri-urban Cambodia

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Background and objectives: Consumption of unhealthy commercial foods and beverages (UCFB) is common among infants and young children (IYC), including IYC living in low- and middle- income countries (LMIC). Such foods can displace consumption of other nutritious foods and reduce dietary adequacy, however, there is limited evidence on how this consumption pattern tracks across the complementary feeding period. This study assessed UCFB consumption patterns of children 10.0 – 18.9 months of age living in rural/peri-urban Kandal province, Cambodia during the complementary feeding period.

Methods: From June 2021-January 2022 we implemented a longitudinal cohort study among 567 caregivers of children aged between 10.0-13.9 months at recruitment. Data was collected monthly across 6 timepoints via a phone survey, including an interviewer-administered questionnaire and a weekly food frequency questionnaire, which captured the child's consumption of foods across nine categories of UCFB. The number of times UCFB were consumed in the previous week was calculated, with a possible range of 0-63 times. UCFB consumption patterns were identified using a mixed-effects Poisson regression model. Logistic regression was used to explore the odds of being high consumer of UCFB at 10.0-13.9 months and at 16.0-19.9 months.

Results: Median [IQR] number of times UCFB were consumed in the previous week increased from 4 [1-8] at 10.0-13.9 months to 11 [7-16] at 16.0-19.9 months. Four UCFB consumption patterns were identified across the complementary feeding period: 1) maintaining a healthy consumption pattern (6.1%); 2) developing an unhealthy consumption pattern (43.7%); 3) improving an unhealthy consumption pattern to a healthy one (4.9%); and 4) maintaining an unhealthy consumption pattern (45.3%). High consumers of UCFB at 10.0-13.9 months had a 4.7 times odds of being high consumers of UCFB at 16.0-19.9 months ($p< 0.001$).

Conclusions: This study found a high prevalence of UCFB consumption patterns in the diets of children 10.0 – 18.9 months. Our findings indicate that high UCFB consumption began during infancy and tracked into childhood. Early interventions are needed to improve infant and young child feeding practices among children under two years of age living in rural/peri-urban Kandal province, Cambodia.

Keywords: Dietary assessment, ultra-processed foods, dietary patterns, phone survey

Conflict of Interest Disclosure: None

OAB(T3)5-5

Learnings from implementers of small quantity lipid-based nutrient supplement (LNS-SQ) programs for children and pregnant and lactating women in Honduras, Niger, and Somalia to strengthen programming and scale-up

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Background and objectives: Small quantity lipid-based nutrient supplements [LNS-SQ], a fortified product, fills nutrient gaps during the complementary feeding period, pregnancy, and while lactating. Strong evidence shows that LNS-SQ effectively reduces stunting, wasting, anemia, and mortality among children aged 6–24 months. A small, but growing number of studies show that LNS-SQ supplementation of pregnant women has positive birth outcomes. However, less is known about the challenges and opportunities for expanding the use of this product and the best approaches to do so. The objectives of this study were to (1) document factors that promoted and/or hindered successful implementation of LNS-SQ programs in highly food insecure emergency contexts, and (2) garner perspectives on considerations for scaling-up.

Methods: We used qualitative methods and convenience sampling to conduct this study in three USAID International Food Relief Partnership–funded LNS-SQ programs in Honduras, Niger, and Somalia. In each country, we interviewed program staff (Niger: 7; Somalia: 8; Honduras: 8) and program participants: caregivers of children 6–24 months (Niger: 18; Somalia: 24; Honduras: 24); and pregnant and lactating women [PLW] (Somalia: 23; Honduras: 24). We also visited warehouses and distribution sites. We coded and analyzed interview transcripts and site visit checklists for themes related to program implementation and considerations for scale-up.

Results: In Niger and Somalia, program participants reported high acceptability of LNS-SQ, but dissatisfaction with the quantity of the product. In Somalia, PLWs requested porridge along with LNS-SQ citing high food insecurity. In both countries, program staff were confident that they could implement the program; however, lack of standard operational guidance on

LNS-SQ-related communication, targeting, and duration of supplementation influenced the quality of implementation. In Niger, program staff reported higher vaccination rates and lower cases of wasting among children who participated in the LNS-SQ program. Considerations for scaling up from program staff, in both countries, included integrating LNS-SQ with the health system. Honduras results forthcoming.

Conclusions: Global organizations need to provide program guidance on how and where to implement LNS-SQ. In areas of high food insecurity, LNS-SQ with a household ration or another specialized nutritious food may be appropriate to improve the nutritional well-being of children and PLW.

Keywords: LNS-SQ, scale-up, Honduras, Niger, Somalia

Conflict of Interest Disclosure: None

OAB(T4)1-1

The medical nutrition therapy of "food order" and "frequent meals" improves ketonuria in women with gestational diabetes mellitus

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Background and Objectives: Gestational diabetes mellitus (GDM) is defined as glucose intolerance first discovered in pregnancy. A ketonic state in diabetic pregnant women has been associated with decreased intelligence in offspring. The aim of this study was to explore the effect of medical nutrition therapy in GDM patients with positive ketonuria.

Methods: The GDM patients with positive ketonuria received individual self-management education of medical nutrition therapy by registered dietitians in Kajiyama Clinic. The dietary advice was patients-centered and focused on "food order" which was consuming vegetable first, then the main dish, and the carbohydrate last. The dietary education of "frequent meals" (4 to 5 meals a day) was also recommended, especially consume a meal between lunch and dinner. The targets of the dietary intervention were to achieve postprandial 2-hour glucose concentration < 120 mg/dl and improve ketonuria. The dietary counseling was conducted 2 sessions for the first month and 1 session/month for 3 months.

Results: A total of 438 GDM, 105 (24%) had positive ketonuria and 333 (76%) had negative ketonuria. The prevalence of BMI in patients with positive ketonuria was lean 21% (BMI < 18.5), normal weight 67% (18.5< BMI < 25.0), and overweight 12% (25.0 < BMI). The ratio of the lean patients with positive ketonuria was higher than 13% that of patients with negative ketonuria. The 99% of the patients with positive ketonuria improved to negative ketonuria after intervention. The intake of carbohydrate per day increased significantly from 119 ± 50 g to 174 ± 44 g after intervention.

Conclusion: Many GDM patients suffer from morning sickness or restrict excessive carbohydrate intake after diagnosis, as a result, a quarter of the patients showed positive ketonuria. The medical nutrition therapy focused on "food order" and "frequent meals" by registered dietitian was effective to improve ketonuria in patients with GDM.

Keywords: gestational diabetes mellitus, medical nutrition therapy, ketonuria, food order, frequent meals

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OAB(T4)1-2

Effects of Premeal Load of Almonds on Glycaemic and other Metabolic Parameters in Asian Indians with Prediabetes: Crossover trial including Continuous Glucose Monitoring.

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Background: Rapid conversion from prediabetes to diabetes and postprandial hyperglycemia (PPHG) is seen in Asian Indians. These should be the target of dietary strategies.

Objectives: We hypothesized that dietary intervention of preloading major meals with almonds in subjects with prediabetes will decrease overall glycemia and PPHG.

Design: In acute crossover randomized study, the effect of a single preload of almond (20 g) given before oral glucose tolerance test (OGTT) was evaluated. The sub-acute phase study using continuous glucose monitoring system (CGMS) for three days after preload of almonds before major meal, was a free-living, open-labelled, crossover randomized control trial, where control and premeal almond load diets were compared for glycaemic control (n=60, 30 each period. The study was registered at clinicaltrials.gov (registration no. NCT04769726).

Results: In the acute phase, the overall AUC for blood glucose, serum insulin, C-peptide, and plasma glucagon post-75 gm oral glucose load was significantly lower for treatment *vs*. control arm (p< 0.001). Specifically, PPHG was significantly lower (18.05%, and 10.07% during OGTT and CGMS, respectively) in the almond preload treatment arm *vs*. control arm. The CGMS data analysis revealed that premeal almond load significantly improved 24-h glucose variability; SD of mean glucose concentration and mean of daily differences. Significant improvement was also seen in several predefined parameters reflecting daily glycaemic control; mean 24-h blood glucose concentration (M), time spent above 140 mg/dL of blood glucose, together with the corresponding AUC values. In addition, significantly lower values were observed for peak 24-h glycaemia, minimum glucose level during night, PPHG and

overall hyperglycaemia (AUC) in the treatment arm *vs.* the control arm.

Conclusion: Incorporation of 20 g of almonds, 30 min before each major meals led to significant decrease in PPHG, insulin, C-peptide, glucagon levels, free fatty acid levels, and decreased several glycemia parameters on CGMS in subjects with prediabetes.

Keywords: Almonds, Postprandial hyperglycaemia, Asian Indians, Prediabetes, Continuous glucose monitoring

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: NA

OAB(T4)1-4

Determinants of anthropometric and socioeconomic risk factors associated with the postprandial blood glucose level in diabetic women of urban Karnataka in India: a hospital-based cross-sectional study

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Background and Objective: Currently, India is housing the second-highest number of people with diabetes (74.2 million) in the world. This mounting number implies a considerable health burden due to diabetes in India in the future. The study aimed to identify the determinants of anthropometric and socioeconomic risk factors associated with the oral glucose tolerance test (OGTT) in diabetic urban women in Karnataka.

Methods: For this cross-sectional study a total of 300 diabetic women aged 35 years and older were randomly selected from six private and four government hospitals in the Vijayapura district of urban Karnataka in India. The primary outcome variable, postprandial blood glucose level was measured by OGTT of the diabetic women. Multivariate linear regression analysis was used to identify significant correlates of OGTT.

Results: The respondents were middle-aged urban women, with a mean age of 58.3 years. About one-third of them had no formal education. The mean (SD) BMI was 24.4 (3.2) which was above the overweight cut-off point for Asians and 12.6% of the women were obese. They had a mean (SD) waist-hip ratio of 0.89 (0.9) which was above the cut-off point for the increased metabolic risk. The mean (SD) value of the OGTT in diabetic women was 234.1 (36.5) mg/dL. When using the multivariate regression model, waist-hip ratio, higher family income, and educational status were found significantly associated with the OGTT of these urban diabetic women of Karnataka. The predictor variables in our model explained 56% variance in OGTT. OGTT value would be expected to be significantly 6.21 mg/dL higher for every 0.01 cm increment in the waist-hip ratio. Women belonging to the families of higher monthly income quartile (more than 650 USD) had increased OGTT values as compared to the women from lower monthly income (less than 260 USD) quartile.

Conclusions: Increased waist-hip ratio, higher family income, and educational status were found to be the significant risk factors of increased postprandial blood glucose levels in urban women in Karnataka. Effective and tailor-made holistic public health initiatives are required to prevent and respond to the diabetes crisis in the urban women of India.

Keywords: Postprandial blood glucose, Urban women, Karnataka

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: Not applicable

OAB(T4)1-5

Dairy Product Consumption in Relation to Incident Prediabetes and Longitudinal Insulin Resistance in the Rotterdam Study

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Background and objectives: Evidence suggests neutral or moderately beneficial effects of dairy intake on type 2 diabetes mellitus risk. Nevertheless, evidence on associations with prediabetes and insulin resistance, early type 2 diabetes phases, remains inconsistent. Considerable heterogeneity between results underlines the need for extensive longitudinal studies. We aimed to examine associations of dairy intake with prediabetes risk and longitudinal insulin resistance in the prospective population-based Rotterdam Study.

Methods: The analytic sample consisted of 6770 participants (aged 62±4 years, 59% female) free of (pre-)diabetes at baseline from the Rotterdam Study. Dairy intake was measured at baseline with food frequency questionnaires. Data on prediabetes and the homeostatic model assessment of insulin resistance (HOMA-IR) were available from 1993–2015. Prediabetes was defined as fasting blood glucose levels of 6.1–6.9 mmol/L or non-fasting levels of 7.7–11.1 mmol/L. Associations with these outcomes were analyzed with dairy intake in quartiles (Q4vsQ1) and continuous using multivariable Cox proportional hazard models and linear mixed models.

Results: During a mean follow-up of 11.3±4.8 years, 1139 incident prediabetes cases were documented (18.8%). In models adjusting for sociodemographic, lifestyle and dietary factors, a higher intake of high-fat yogurt was associated with a lower prediabetes risk (HR_{Q4vsQ1} 0.70, 95%CI 0.54–0.91 and $HR_{serving/day}$ 0.67, 0.51–0.89). In addition, a higher intake of high-fat milk was associated with a lower prediabetes risk (HR_{Q4vsQ1} 0.81, 0.67–0.97, $HR_{serving/day}$ 0.88, 0.79–0.99). Associations were found for low-fat dairy, low-fat milk, and total cheese with a higher

prediabetes risk ($HR_{serving/day}$ ranging from 1.05–1.07, not significant in quartiles). Associations with longitudinal HOMA-IR were similar to prediabetes for high-fat yogurt, low-fat dairy and low-fat milk. Fermented dairy, low-fat yogurt, high-fat cheese, cream and ice cream were not associated with the outcomes.

Conclusions: In this large cohort study with long-term follow-up, a higher intake of high-fat yogurt was associated with a lower prediabetes risk and lower longitudinal insulin resistance. Additionally, high-fat milk was associated with a lower prediabetes risk. Some low-fat dairy types were inconsistently associated with these outcomes. Further studies are needed to confirm associations and to examine the influence of confounding by population characteristics.

Keywords: Nutrition, Dairy, Epidemiology, Food, Diabetes

Conflict of Interest Disclosure: The authors declare no conflict of interest.

OAB(T4)1-6

Interplay between diet, gut microbiota and plasma metabolomic profile in relation to insulin resistance

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Background and objectives: Dietary compounds, including many bioactive lipids, are metabolized by bacteria in the gastrointestinal tract, generating circulating metabolites with potential metabolic and endocrine activities. Alterations in the intestinal microbiota (dysbiosis) found in individuals with obesity or insulin resistance may affect the composition of the metabolome, playing a fundamental role in the development of the associated metabolic alterations. In this work we have analyzed the alterations in the gut microbiome and plasma metabolome associated with insulin resistance in a Spanish population.

Methods: A total of 361 volunteers from the Obekit trial (65 normal-weight, 110 overweight and 186 obese) were classified according to two variables: serum insulin levels (above 8 U/mL) and triglyceride-glucose index (TGI; TGI above 4.5). Those individuals who did not exceed the threshold value in any variable were considered as LOW insulin resistance group, while those subjects who did exceed the threshold value in 1 or 2 variables as HIGH insulin resistance group. Sequencing of the V3-V4 region of the 16S rRNA gene was performed in fecal samples from all participants, and differential abundance analyses for phylum, family and genera were performed using the MicrobiomeAnalyst web-based platform. Untargeted metabolomic analysis in plasma samples of individuals from the HIGH and LOW insulin resistance groups was performed, and principal component analysis (PCA), partial least squares-discriminant analysis (PLS-DA) and volcano plot were carried out for the pattern recognition and characteristic metabolites identification.

Results: Individuals with HIGH insulin resistance exhibited a significant reduction in the Shannon and Simpson alpha diversity indexes, a reduction in Firmicutes and Actinobacteria, and an increase in Bacteroidetes and Proteobacteria. Coriobacteriaceae family was found to be significantly less abundant in individuals with HIGH insulin resistance. Untargeted metabolomic analyses revealed differentially abundance of bioactive sphingolipids, such as sphingomyelin (SM), ceramide (Cer) or sphingosine-1-phosphate (S1P), between individuals with HIGH and LOW insulin resistance.

Conclusions: Differences in gut microbiota composition might affect the metabolism of different bioactive molecules such as sphingolipids, whose activity seems to be associated with the development of insulin resistance.

Keywords: postbiotic, alpha diversity, ceramide, HOMA index, dysbiosis

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OAB(T4)1-7

The influence of lifestyle interventions on continuously measured glucose levels in people with type 2 diabetes: an N-of-1 analysis.

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Background and objectives: Individuals with T2D might benefit from different types of lifestyle interventions, depending on their underlying pathophysiology. Measuring the effects of lifestyle on continuous glucose levels can provide insight into the potential of personalized lifestyle advice. In this study we aim to investigate the effects of four lifestyle interventions on continuously measured glucose levels in people with T2D.

Methods: Forty individuals with T2D treated with lifestyle advice and/or metformin were recruited. During half a year, participants underwent 11 monitoring periods of four days, including three control periods and eight intervention periods. The lifestyle interventions included a low-carbohydrate diet (LC), a Mediterranean diet (Med), walking after every meal (Walk) and five minutes of physical exercise every hour (Active). All four interventions were followed twice. During the monitoring periods, participants used a continuous glucose monitor, and self-monitored their lifestyle. To investigate the effect of the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

interventions on individual glucose levels we used an n-of-1 approach or linear mixed model.

Results: Preliminary results are presented for the first 19 participants. At baseline participants had a mean age of 61.5 ± 5.3 years, BMI of 29.6 ± 3.4 kg/m2, HbA1c of 53.0 ± 10.2 mmol/mol and fasting plasma glucose of 7.8 ± 1.1 mmol/L. Results from the linear mixed model including monitoring period, subject and HbA1c showed that the mean daily glucose during the control period was 8.7 ± 0.5 mmol/L, and that all four interventions resulted in lower average daily glucose levels with the largest effect for the LC intervention (-0.83 ± 0.29 mmol/L), followed by the Walk (-0.36 ± 0.20 mmol/L), Active (-0.25 ± 0.16 mmol/L) and Med (-0.17 ± 0.24 mmol/L) intervention. During the IUNS-ICN, longitudinal data and accompanying n-of-1 analysis for the total study population (n=40) will be presented, to provide insight in what factors may explain the differential response to interventions between individuals.

Conclusion: Preliminary analyses for the first 19 participants show a differential response to the four lifestyle interventions, with the highest glucose values during the Med and the lowest during the LC intervention. However, individual differences seem to exist in response to these lifestyle interventions.

Keywords: Continuous glucose monitoring, Lifestyle, N=1 approach , Type 2 diabetes, Self-monitoring

Conflict of Interest Disclosure: This work is performed within the Gluco-Insight project, a public-private partnership between TNO, LUMC, Ekomenu, Roche and Reinier Haga MDC. The project is co-funded by the PPP Allowance made available by Health~Holland, Top Sector Life Sciences & Health, to stimulate public-private partnerships.

Further Collaborators: We thank Frans van der Horst (Reinier Haga Medical Diagnostic Center), Jack Stroeken (Ekomenu B.V.) and Gert Bergman (Roche Diabetes Care Nederland B.V.) for the fruitful cooperation and their contribution to this project.

OAB(T4)1-8

No sugarcoating: Development of digital nutrition modules for prediabetics based on real-life experiences

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Background and objectives: Prediabetes is the intermediate state between normal glycemia and diabetes. A person with prediabetes is at risk of serious health complications. A healthy lifestyle is essential for managing prediabetes, and effectiveness is enhanced when taking into account life circumstances. Hence, this study aimed to develop evidence-based nutrition modules, addressing the current needs of prediabetics based on qualitative data.

Methods: One-to-one in-depth semi-structured interviews were conducted among prediabetics to gain insights into the facilitators and challenges relating to a healthy lifestyle. Malaysian prediabetics (aged 18 years and above) were recruited purposively until saturation was reached. Interview recordings were transcribed verbatim using Otter.ai and manually checked. NVivo Plus software assisted in the thematic analysis of the qualitative data. Considering the qualitative findings, nutrition modules were developed by nutritionists and dieticians using evidence-based information, alongside the animation software Vyond and design tool CanvaPro. The modules were further pilot tested among prediabetics to gain feedback on the usability aspect.

Results: Major themes emerged including (1) barriers- lack of support from healthcare professionals, financial constraints, lack of time, food/taste preferences, restrictions due to the Covid-19 pandemic; (2) enablers- family support, motivations to be healthy, habit formation, clear and simple nutrition-related information, food skills, the use of technology and incentive-based rewards. Addressing the current needs, comprehensive yet concise modules were developed in the form of digital infographics and videos. Various topics were covered, including energy balance, starchy foods, sugar, sweeteners, glycemic index, fats, healthful foods, processed foods, meal plans for prediabetics, food skills (cooking methods, food labels) and lifestyle (physical activity, alcohol, smoking, stress, sleep). Overall, positive feedback was received in terms of the modules' practical usability, content, design, and language structure.

Conclusions: Prediabetes presents a window of opportunity to prevent diabetes. Lifestyle changes and dietary guidance that consider current challenges individuals face are likely to be more effective and sustainable. Key factors to incorporate in the management of prediabetes include practical and straightforward nutrition knowledge along with the motivations to support healthy behaviors. The modules developed are useful for prediabetics and healthcare professionals to provide high-quality interventions tailored to the current needs.

Keywords: Prediabetes, Nutrition education, Qualitative research, Digital health

Conflict of Interest Disclosure: Not applicable.

Further Collaborators: Not applicable.

OAB(T4)1-9

Mediterranean diet and aerobic exercise modulate immunometabolism-related genes in overweight individuals with pre-diabetes

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Background and objectives: According to the World Health Organization (WHO), in 2030, diabetes will be one of the leading causes of death. In the early phases of the disease, a pre-diabetic stage develops with impaired fasting glucose associated with a chronic low-grade inflammation. Lifestyle modifications while

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

the patient is still in the pre-diabetes stage have been shown to be effective in preventing or delaying the onset of diabetes. Herein, the main objective of this study is to evaluate the effects of Mediterranean diet-associated patterns and aerobic exercise on immunometabolism-related genes in overweight individuals with prediabetes.

Methods: All participants followed a low-energy diet (5.5 MJ/1315 kcal/daily) and aerobic exercise following WHO recommendation (at least 150 minutes of moderate-intensity aerobic physical activity each week) for 12 weeks. Participants were recruited from Marchena (Seville, Spain). Those eligible for inclusion were individuals with abdominal obesity (waist circumference **>** 94cm in men and **>** 88cm in women) and pre-diabetes (HOMA-IR **>** 2,78). Anthropometric and biochemical measures were carried out at baseline, 3, 6, and 12 weeks. At these points, peripheral blood mononuclear cells (PBMCs) were isolated and were used to analyse the effects of the nutritional and physical intervention on immunometabolism-related genes by using RT-qPCR.

Results: In total, 20 individuals (15 women, 5 men) attended the baseline visit and completed the follow-up visit. All the participants had a significantly decrease in BMI, lean mass, fat mass, glucose, TC, TG, HDL-C and LDL-C. $p < 0.05$). The results showed that there were differences in multiple lipid *CD36*, *PPARG* and glucose metabolism *SREBP-1, ACLY, GLUT1, GLUT3, GLUT5* and immune response, *C3*, *IL-1B, IL-6, IL-10, IL-13, IL-17, IL-18, TNFA, IL1R1, IL1R2, TNFRII* between the pre- and post-intervention analysis.

Conclusions: In overweight patients with pre-diabetes, Mediterranean diet-associated patterns and aerobic exercise improves insulin sensitivity and decreases risk of progression toward diabetes by modulating immunometabolism related genes.

Keywords: Mediterranean Diet, Aerobic Exercise, Immunometabolism, Diabetes, Insulin Resistance

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OAB(T4)2-1

The association of dietary Inflammatory Index with long-term all-cause and cardiovascular mortality risk: NIPPON DATA80

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Background and objectives: Pro-inflammatory diet may increase the risk of cardiovascular disease (CVD) and all-cause mortality risk. It is confirmed in other countries, but Japanese studies are scarce. The aim of this study was to examine the association of pro-inflammatory diet with all-cause and CVD mortality risk in a long-term follow-up study of representative Japanese population.

Methods: NIPPON DATA80 is a prospective cohort study of the National Survey on Circulatory Disorders and the National Nutrition Survey conducted in 1980 in 300 randomly selected districts throughout Japan. We excluded those who had missing information, CVD history at baseline, extreme energy intake, and loss to follow-up, leaving 9,142 individuals at baseline (56% women, 30–92 years). Twenty nutrient parameters (protein, total fat, carbohydrate, vitamin A, vitamin B1, vitamin B2, vitamin C, niacin, vitamin E, magnesium, fiber, cholesterol, saturated fat, monounsaturated fatty acid, polyunsaturated fatty acid, n-6 fatty acid, n-3 fatty acid, total trans fatty acid, β-carotene) derived from a 3-day weighing dietary records were used to calculate the Dietary Inflammatory Index (DII) scores. We used energy-adjusted DII (E-DII) by the residual method. Higher E-DII score indicates that diet is more pro-inflammatory. The ICD-9 and ICD-10 ascertained mortality from CVD (393–459 (ICD-9) and I00–I99 (ICD-10)) in 29-year follow-up period until 2009. Cox proportional hazards model was performed to calculate hazard ratios (HRs) adjusted for age, sex, body mass index, smoking status, drinking status, serum total cholesterol, diabetes history, hypertension status and sodium intake. We also examined the interaction between E-DII and sex.

Results: There were 3,412 all-cause and 1,162 CVD deaths during an average follow-up of 24.4 years. The mean of E-DII score was -0.44 (SD: 1.14). The multivariable-adjusted HR per 1 standard deviation increase of E-DII score was 1.09 (95%CI: 1.06 -1.13) for all-cause mortality, 1.15 (95%CI: 1.08 -1.22) for CVD mortality, 1.24 (95%CI: 1.08 -1.42) for coronary heart disease mortality and 1.13 (95%CI: 1.03 -1.24) for stroke mortality. There were no interactions between E-DII and sex.

Conclusions: The E-DII score was positively associated with the long-term risk of all-cause and CVD mortality in a nationally representative Japanese population.

Keywords: dietary inflammatory index, cardiovascular disease, mortality, prospective study

Conflict of Interest Disclosure: No Conflict of Interest Disclosure

Further Collaborators: Akiko Harada (Shiga University of Medical Science) and Kaori Kitaoka (Shiga University of Medical Science)

OAB(T4)2-2

Dietary amino acids and risk of stroke subtypes: a prospective analysis of 356,000 participants in seven European countries.

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Background and objectives: Little is known about the relevance of dietary amino acids to risk of stroke subtypes. We examined the associations of dietary amino acids with ischaemic

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

and haemorrhagic stroke in the EPIC (European Prospective Investigation into Cancer and Nutrition) study.

Methods: We analysed data on 356,142 people from seven European countries (Denmark, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom). Dietary intakes of 19 individual amino acids were obtained using validated country-specific food frequency questionnaires, calibrated using additional 24-hour recalls. Blood pressure was measured at recruitment in 267,642 (75%) participants. Multivariable Cox regressions adjusted for socio-demographic characteristics, lifestyle factors and medical history were used to estimate hazard ratios (HRs) of ischaemic and haemorrhagic stroke for 1 standard deviation (SD) differences and fifths of intakes of each individual amino acid.

Results: After a mean follow-up of 12.7 years, 4295 people had an ischaemic stroke and 1375 people had a haemorrhagic stroke. After mutual adjustment for all amino acids and corrected for multiple testing, higher intake of proline was found to be associated with 12% lower risk of ischaemic stroke (HR [95% CI] of 0.88 [0.82-0.94] for 1SD higher calibrated intake in multivariable-adjusted model). The association was independent of systolic and diastolic blood pressure. Among dietary sources of protein, intake of proline was most strongly correlated with intake of dairy protein (Pearson correlation coefficient r=0.73) in the current study. Higher intakes of isoleucine, leucine, valine, phenylalanine, threonine, tryptophan, glutamic acid, serine and tyrosine were associated with lower risks of ischaemic stroke in the multivariable model, but all these associations attenuated when adjusted for proline. For haemorrhagic stroke, no statistically significant associations were observed in the continuous analyses after correcting for multiple testing.

Conclusions: Higher intakes of proline were associated with lower risks of ischaemic stroke, independent of other dietary amino acids. Further studies are needed to assess the casual relevance and possible implications for prevention.

Keywords: nutritional epidemiology, dietary protein, amino acids, stroke, prospective cohort

Conflict of Interest Disclosure: None

Further Collaborators: This work is presented by the first author on behalf of the EPIC-CVD consortium

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OAB(T4)2-3

Association of the Portfolio Diet with Total and Cardiovascular Disease Mortality in the Women's Health Initiative

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Background and Objectives: The Portfolio Diet is a plant-based dietary pattern of established cholesterol-lowering foods. The diet has been shown to improve a number of cardiovascular disease (CVD) risk factors, including low-density lipoprotein cholesterol (LDL-C), blood pressure, and C-reactive protein (CRP) in clinical trials, and has been associated with lower CVD incidence in a prospective cohort. As yet, there have not been any large prospective studies directly assessing the relation of the Portfolio Diet to total and CVD mortality.

Methods: We followed 109,445 postmenopausal women initially free of CVD, diabetes, and cancer in the Women's Health Initiative (WHI) Clinical Trials and Observational Study from 1993 to 2021. Adherence to the Portfolio diet was assessed using an *a priori* diet index based on six food categories (high in plant protein [soy & pulses], nuts, viscous fiber, phytosterols and monounsaturated fat, and low in saturated fat and dietary cholesterol) via a food frequency questionnaire at baseline and year three. Adjusted hazard ratios (HRs) and 95% confidence intervals [CIs] for CVD incidence and death and total mortality were calculated using Cox regressions, adjusted for potential confounders (including age, race/ethnicity, family history, lifestyle and dietary factors, and medication use).

Results: Over a mean of 17.4 years of follow-up, there were 11,597 cases of incident total CVD, 4,695 cases of coronary heart disease (CHD), 4,215 cases of stroke, 7,624 cases of CVD death, and 28,162 total deaths. Comparing the highest to the lowest quartile in the fully adjusted model, higher adherence to the Portfolio diet was associated with a reduced risk of total CVD (HR=0.89 [95% CI 0.83-0.95]), CHD (0.85 [0.77-0.95]), CVD death (0.93 [0.86-1.01]), and total mortality (0.89 [0.85-0.92]). No association was found with stroke (1.03, [0.92-1.16]).

Conclusions: In postmenopausal women, higher adherence to the Portfolio diet was inversely associated with total CVD, CHD, and total mortality, but not stroke. These prospective data provide the notion that the plant-based Portfolio diet may have direct benefits on CVD and mortality prevention in postmenopausal women.

Keywords: portfolio diet, cardiovascular disease, mortality, prospective cohort

Conflict of Interest Disclosure: AJG has received consulting fees from Solo GI Nutrition and has received an honorarium from the Soy Nutrition Institute.

CWCK, DJAJ, and JLS have each received funding support, honoraria, consulting, and/or travel fees from a broad range of

food, beverage, and ingredient companies, trade associations, government agencies, health charities, private foundations, and/or other commercial or non-profit entities with an interest in nutrition and chronic disease prevention and management. For a complete list of disclosures, please see https://www.ahajournals.org/doi/10.1161/JAHA.121.021515

AJH received independent investigator-initiated research funding from Dairy Farmers of Canada.

All other authors report no competing interests.

Further Collaborators: Anthony J Hanley, Jie Li

OAB(T4)2-4

Partial substitution of red meat with plant-based foods and the risk of cardiovascular diseases: a pooled analysis of three Finnish cohorts

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Background and objectives: Cardiovascular diseases (CVD) constitute a major burden to public health and welfare worldwide. High consumption of red meat has been associated with increased risk of CVD whereas high consumption of plant-based foods is linked to decreased risk of these diseases. Moreover, a shift from animal-based foods to plant-based foods is necessitated to enhance environmental sustainability. We aimed to investigate whether moderate partial substitution of red meat (beef, pork, lamb, game, offal) with plant-based foods (legumes, vegetables, fruit, cereals, and different combinations of these) is associated with the risk of CVD in Finnish adults.

Methods: We used data from three Finnish cohorts (pooled n=14 915, 44% men, age 25 years or over at baseline, 10.8 years median follow-up with 1263 incident CVD cases). A validated food frequency questionnaire served dietary assessment. In the substitution models, 100 g/week of red meat were substituted with similar amounts of plant-based foods. Cohort-specific hazard ratios (HR) were calculated using Cox proportional hazards multivariable model adjusting for relevant confounders. Pooled HRs were estimated from the cohort-specific HRs using a random-effects model.

Results: We found a small statistically significant reduction in CVD risk in women when red meat was partially substituted with cereals (HR 0.96, 95% CI 0.93-0.99, P=0.020). In addition, a reduction was observed, when red meat was partially substituted with the combination of cereals and legumes in the unadjusted model (HR 0.96, 95% CI 0.932-1.00, P=0.029) slightly attenuating in the fully adjusted model (HR 0.97, 95% CI 0.94-1.00, P=0.086). In men, no significant associations were observed for the corresponding substitutions (cereals: HR 1.01, 95% CI 0.985-1.032, P=0.49, cereals and legumes: HR 1.01 95% CI 0.98-1.03, P=0.50). Furthermore, no significant associations were found for the other studied plant-based substitutes.

Conclusions: The partial substitution of red meat with cereals was associated with reduced CVD risk in women. The results suggest that even a small change in diet may be beneficial in terms of reducing CVD risk. Such dietary changes are also needed to ameliorate environmental sustainability. The sex difference in results warrant further study.

Keywords: cardiovascular diseases, plant foods, red meat, substitution, sustainability

Conflict of Interest Disclosure: The authors have no conflicts of interest to declare.

Further Collaborators: The Legumes for sustainable food system and healthy life (Leg4Life) study group. The presented research was funded by the Strategic Research Council at the Academy of Finland (grant numbers 327699, 327698).

OAB(T4)2-5

Non-alcoholic fatty liver disease and risk of mortality and type 2 diabetes after myocardial infarction: a prospective analysis in the Alpha Omega Cohort.

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Background and objectives: Non-alcoholic fatty liver disease (NAFLD) has been associated with a higher risk of cardiometabolic disease in population-based studies. Little is known about these associations in patients with a history of myocardial infarction (MI). We examined the Fatty Liver Index (FLI) ≧60, as a validated marker of NAFLD, in relation to risk of cardiovascular disease (CVD) mortality, all-cause mortality and type diabetes (T2D) among post-MI patients.

Methods: We included 4165 Dutch patients from the Alpha Omega Cohort aged 60-80 years who had an MI ≦10 years prior to study enrolment. FLI was based on BMI, waist circumference, triglycerides, and gamma-glutamyltransferase. Cause-specific mortality was monitored from enrolment (2002-2006) through December 2018, and T2D incidence was monitored during the first 40 months of follow-up. Multivariable Cox regression was used to obtain hazard ratios (HR) with 95% confidence intervals (95% CI) for fatal endpoints in FLI categories, using FLI <30 (indicating no NAFLD) as the reference. Analyses were repeated in strata of obesity (BMI <30; BMI ≧30) and prevalent T2D, using FLI <60 as the reference. In 3201 non-diabetic patients we studied FLI ≧ 60 with T2D incidence compared to FLI <60.

Results: Patients had a mean FLI of 62.3 (± 22.8) of which 10% had FLI <30 and 60% had FLI ≧60. Patients with FLI ≧60 were more likely to be male (80%) and had more often diabetes at baseline (25%) compared to patients with FLI <30. During a

median follow-up of 12 years (46,072 person-years) we observed 1934 deaths of which 795 were due to CVD. Patients with FLI ≧ 60 had a higher risk of CVD mortality (HR: 1.59 [1.21, 2.12]) and all-cause mortality (HR: 1.20 [1.02; 1.42]) compared to patients with FLI <30. Results remained similar in strata of T2D and BMI <30, but were non-significant in obese patients. FLI ≧60 was associated with T2D incidence (182 cases; HR: 2.78 [1.95, 3.96]).

Conclusions: NAFLD, based on FLI ≧60, was a predictor for CVD mortality, all-cause mortality, and T2D in post-MI patients. These results may have implications for risk prediction and multidisciplinary disease management.

Keywords: Cardiovascular, Diabetes, Obesity, Prevention

OAB(T4)2-6

Association between food preference and health outcomes: findings from the UK Biobank prospective cohort study.

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Background and objectives: Food preferences are a key influence on food consumption. However, most available evidence focuses on cross-sectional associations between food preferences and obesity. Therefore, we aimed to determine associations between food preferences and risk of cardiovascular diseases (CVD), type 2 diabetes (T2D), cancer and all-cause mortality (ACM) in a prospective cohort study.

Methods: 173,212 participants (57.1% women; mean age 55.8 years) from the UK Biobank cohort were included. The median follow-up was 9.2 years (interquartile range 9.6 to 9.9). Based on self-reported food preferences, liking was measured using a 9-point hedonic scale, from 1 (extremely dislike) to 9 (extremely like). 17 food groups were included in the preference for High Fat Savoury (HFS), 9 in High Fat Sweet (HFSw), 17 in Low fat Savoury (LFS) and 13 in Low fat Sweet (LFSw). Cox proportional hazard models were used to investigate associations with incidence of CVD, T2D, and colorectal, lung, breast, prostate cancer, all-cause cancers, and ACM. Results are presented as Hazard Ratio (HR) with 95% Confidence Interval (CI) per one point increment in the hedonic scale.

Results: Individuals had a 13% higher risk of T2D per 1-point increment in the HFS hedonic scale (HR 1.13; 95%CI: 1.08-1.18). Individuals with preference for HFSw food had an increased risk of ACM (HR 1.08; 95%CI: 1.01-1.15), colorectal (HR 1.07; 95%CI 1.02-1.11), prostate cancer (HR 1.04; 95%CI 1.01-1.07), and all-cause cancer (HR 1.03; 95%CI 1.01-1.04). They also had a lower risk for CVD and T2D. Individuals with preference for LFS food had lower risk of ACM (HR 0.85; 95%CI 0.79-0.92), T2D (HR 0.90; 95%CI 0.86-0.94), colorectal cancer (HR 0.90; 95%CI 0.85-0.95), CVD (HR 0.94; 95%CI 0.93-0.96), and all-cause cancer (HR 0.97; 95%CI 0.96-0.99). Those with preference for LFSw food had lower risk of T2D (HR 0.90; 95%CI 0.86-0.95), colorectal cancer (HR 0.94; 95%CI 0.89-1.00), and CVD (HR 0.96; 95%CI 0.94-0.98).

Conclusion: Preferences were associated differentially with specific health outcomes. Preference for HFS food was associated with higher T2D risk, whilst preference for LFS food and LFSw food was associated with lower risk of mortality, CVD, T2D, and some cancers.

Keywords: Food preferences, cardiovascular disease, cancer, type 2 diabetes, Liking

Conflict of Interest Disclosure: None Disclosed

OAB(T4)2-7

Association between dairy intake and risk of incident functional disability in Japanese older adults: the Ohsaki Cohort 2006 Study

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Background and objectives: Only a few studies have examined the association between dairy intake and incident functional disability, and it remains unclear whether increasing dairy intake may protect against functional disability. Thus, this study aimed to investigate this association in Japanese older adults.

Methods: We conducted a longitudinal analysis of dairy intake and incident functional disability in a prospective cohort study of 11,911 (44.4% men) disability-free Japanese individuals aged ≧65 years in 2006, who were followed up for up to 13 years. Data on milk, yogurt, and cheese intake were obtained using a validated 39-item food frequency questionnaire at baseline. Total dairy intake was calculated as the sum of milk, yogurt, and cheese intake and then categorized by quintiles (Q1 to Q5). Data on incident functional disability were retrieved from the public Long-term Care Insurance database. Participants were followed-up from December 16, 2006 to November 30, 2019. Cox proportional hazards models were used to estimate the multivariable-adjusted hazard ratios (HRs) and 95% confidence intervals (95% CIs) for incident functional disability.

Results: During 107,344 person-years of follow-up, 5,749 cases (48.3%) of incident functional disability were documented. Results suggested that total dairy intake was not associated with risk of incident functional disability. Compared with Q1 (the lowest quintile), the multivariable-adjusted HRs (95%CIs) were 0.98 (0.90-1.06) for Q2, 0.94 (0.86-1.02) for Q3, 0.97 (0.89-1.05) for Q4, and 1.04 (0.95-1.13) for Q5 (the highest quintile) *p* for trend=0.529). We also examined the association between each dairy product (i.e., milk, yogurt, and cheese) intake frequency and incident functional disability, but no association was found. Furthermore, a sensitivity analysis was conducted by excluding

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

cases of functional disability documented in the first three years, but the null findings remained unchanged.

Conclusions: Our study suggests that dairy intake is not associated with incident functional disability in Japanese older adults.

Keywords: Epidemiology, Cohort study, Dairy intake, Functional disability

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T4)3-1

The effects of 20-week exercise on whole-blood genome-wide DNA methylation profile in children with overweight/obesity

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Background and objectives: Effects of an exercise intervention on human molecular profiles (epigenomics and transcriptomics) are unstudied in the pediatric population. Here, we aimed to investigate the effects of a 20-week exercise intervention on whole blood genome-wide DNA methylation signatures (CpG sites level) and the consequent changes on transcriptome profile (RNAseq) in boys and girls with overweight/obesity (OW/OB).

Methods: Twenty-three children (10.05 ± 1.39 years, 56% girls) with OW/OB, were randomized to either a 20-week exercise intervention (exercise group [EG]; n=10; 4 boys/ 6 girls), or to usual lifestyle (control group [CG] (n=13; 6 boys/ 7 girls). Whole blood genome-wide DNA methylation and transcriptome profile (RNA-seq) analyses were performed before and after the intervention period.

Results: Changes in the DNA methylation sites of 485 and 386 CpGs were induced by the exercise intervention (compared to the control group) in boys and girls respectively ($p < 0.001$). These CpG sites mapped to loci enriched in distinct gene pathways related to metabolic diseases, fatty acid metabolism, and immune function in boys or girls ($p < 0.05$). In boys, changes on the DNA methylation status of 87 CpG sites (from the subset of 485 significant CpGs) associated with changes in the gene expression levels of 51 gene transcripts which were regulated by exercise ($p < 0.05$). Among girls, changes on DNA methylation at 46 CpG sites (from the initial 386 significant CpGs) were associated with changes in the gene expression levels of 30 gene transcripts affected by exercise. Gene transcripts affected by exercise-induced DNA methylation were related to obesity, metabolic syndrome, and inflammation. Nevertheless, none of the presented analyses survived multiple testing correction (FDR > 0.05).

Conclusions: Our multi-omics approach reveals that exercise may regulate gene pathways involved in metabolism and immune functions in blood cells of boys and girls with OW/OB. Our preliminary results provide important first step to characterize the molecular response to exercise interventions in pediatric population. Future randomized controlled trials involving larger sample sizes are needed.

Keywords: exercise, obesity, pediatrics, epigenetics, gene expression

Conflict of Interest Disclosure: None to disclose.

OAB(T4)3-2

Comparison of the effects of different fats and oils on obesity and their mechanism

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Background and objectives: Excessive fat intake causes the onset and exacerbation of lifestyle diseases. Although fat has high-calory, it has been reported that certain fats and oils do not induce lifestyle-related diseases. Therefore, it is important to choose the types of fats and oils to maintain health. However, the comparison of the effects of fats and oils on the onset of lifestyle diseases and their mechanisms are not fully understood. In this study, we compared the effects of six fats and oils on obesity and their mechanism in mice.

Methods: C57BL/6J male mice were fed standard diet (SD) and high-fat diets (HF) for 15 weeks. SD contained 5% (w/w) corn oil, while HF contained 20% (w/w) fats or oils as follows: lard (Lard), palm oil (Palm), rapeseed oil (Rape), high oleic safflower oil (Saff), corn oil (Corn) and flaxseed oil (Flax). At the end of experiment, liver, white adipose tissue, and brown adipose tissue were collected and weighed. The liver and adipose tissue were subjected to the estimation of lipid and energy metabolisms.

Results: Final body weight and white adipose tissue weight in HF-Lard and HF-Palm groups were significantly higher than those of SD group, but they didn't change in HF-Corn and HF-Flax

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

groups. In the liver, the protein expression levels of lipogenesis-related proteins, ACC and FAS, in HF-Flax group tended to decrease those in other groups. In the epididymal white adipose tissue, the protein expression level of CPT1A tended to decrease in HF-Lard, HF-Palm, and HF-Saff groups, while increase in HF-Flax group compared with SD group. Significant difference was observed in HF-Flax group against other three groups. Protein expression of UCP-1 significantly increased in brown adipose tissue of HF-Corn and HF-Flax groups compared with SD, HF-Lard, and HF-Palm groups.

Conclusions: Increase in the white adipose tissue weight in HF-Lard and HF-Palm groups was expectedly observed due to rich in saturated fatty acids. Among the polyunsaturated fatty acids-rich groups, HF-Flax group was superior for amelioration of lipid and energy metabolism, suggested that an intake of α-linoleic acid-rich oil may not induce obesity by maintaining lipid metabolism and increasing energy metabolism.

Keywords: fat and oil, obesity, flaxseed oil, α-linolenic acid, polyunsaturated fatty acid

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OAB(T4)3-3

Dietary patterns, genetic risk, and incidence of obesity: application of reduced rank regression in 11,735 adults from the UK Biobank study

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Background and objectives: Few studies have derived dietary patterns based on intake of discretionary foods and beverages and examined associations with genetic risk and obesity. We examined associations between dietary patterns based on discretionary foods, saturated fatty acids (SFA), and fiber, with a polygenetic risk score (PRS) for obesity and risk of overall obesity, central obesity and high body fat (BF) up to 9.7 years later.

Methods: Data from 11,735 adults from the UK Biobank cohort study were used. Dietary patterns were derived from 24-hour dietary assessments using reduced rank regression (response variables: discretionary foods and beverages [%E]; SFA [%E]; fiber density [g/MJ]). Cox proportional hazard models were used to investigate associations between dietary patterns and incident overall obesity, central obesity and high BF, with interactions by PRS.

Results: Three dietary patterns (DP) were identified. DP1, correlated positively with discretionary foods and SFA, inversely with fiber, was associated with higher risk of central obesity (hazard ratio: 1.08; 95% confidence interval: 1.02, 1.14). DP2, correlated positively with discretionary foods and fiber, inversely with SFA, and was not associated with obesity incidence. DP3, correlated positively with SFA and fiber, inversely with discretionary foods, was associated with lower risk of central obesity (hazard ratio: 0.92; 95% confidence interval: 0.87, 0.98). There was limited evidence of interactions with PRS.

Conclusions: A dietary pattern high in high-SFA and low-fiber discretionary foods and beverages was associated with higher risk of obesity, independent of genetic predisposition.

Keywords: obesity, dietary patterns, reduced rank regression, discretionary foods, cohort study

Conflict of Interest Disclosure: KML is supported by a National Health and Medical Research Council Emerging Leadership Fellowship [APP1173803]. JW is funded by the Lister Prize Fellowship [173096]. All authors declare that they have no conflict of interest to declare.

Further Collaborators: N/A

OAB(T4)3-4

Effect of online weight management intervention for adults with obesity during COVID-19 pandemic

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Background and objectives: Adults were more prone to experience the shifts in their lifestyle patterns leading to excess weight gain during the *COVID-19* pandemic. Following a weight management intervention through lifestyle modification was quite challenging with the lock down and social distancing. Therefore, this study was conducted with the objective of investigating the effect of online weight management intervention during the *COVID-19* pandemic.

Methods: A randomized controlled study was conducted for fifteen weeks (t=15 weeks) with 40 (n=40) obese adults. Obese individuals were randomly allocated either to receive online weight management intervention (treatment group; n=20) or general weight management education for obesity management (control group; n=20). The online weight management intervention package consisted of short motivational messages, text messages, web posts and blog articles related to diet and physical activity modification and online structured counseling sessions on diet and physical activity modification by a registered dietitian. Body weight, waist and hip circumferences, physical activity level, and dietary intake of both groups were measured at the baseline (t=0 weeks) and end (t=15 weeks) of the intervention.

Results: Weight and waist circumference of the treatment group was significantly reduced $P < 0.05$) at the end compared to the baseline. There were no any significant reductions of weight and waist circumference observed in the control group. Further, obese adults who received online weight management intervention showed significant $P < 0.05$) reductions in their weight and waist circumferences compared to group who received the general lifestyle management education. Total

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DOI: 10.1159/000530786

energy intake, energy from carbohydrates and fat were significantly *P* <0.05) reduced in the treatment group.

Conclusions: According to the findings, it can be concluded that the online weight management intervention was effective in reducing the weight and waist circumference of the obese individuals and dietary modifications may have contributed to the improvements.

Keywords: Obesity, Weight management, Lifestyle modification, Diet, Physical activity

Conflict of Interest Disclosure: Not applicable

Further Collaborators: Not applicable

OAB(T4)3-5

Snacking is not associated with BMI in those with a healthy dietary pattern: ZOE Health study in 683,472 participants

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Background and objectives: Snacking accounts for 20-25% of daily energy intake, making it a key determinant of dietary quality. However, whether the snacking 'event' itself (multiple eating events and extended eating periods) or the poor dietary quality of snacks is associated with unfavourable health outcomes is unknown. Here we explore the association between snacking patterns, body composition and diet quality.

Methods: Diet data (food frequency questionnaire (FFQ)) and baseline characteristics (sex, age, socio-economic status (SES) and body mass index (BMI)) were analysed from 683,472 participants of the ZOE Health smartphone app. Self-reported daily snacking frequency (eating events between main meals) and diet quality (Diet Quality Score (DQS)) was assessed. The relationship between snacking frequency, diet quality and BMI (linear regression analysis adjusted for age, sex, eating window and SES) was investigated and post-hoc analysis carried out in age-matched subgroups.

Results: Average daily snack intakes in consumers was 1.89 portions (95% CI 1.88-1.89) (total cohort; 1.65 (95% CI 1.65-1.66)); 12% of participants did not snack, 36% consumed 1 snack/d, 34% 2 snacks/d and 18% > 2 snacks/d (frequent snackers). Frequent snackers versus non-snackers had a higher proportion of females (72% *vs* 58%), were younger (mean±SD) (47±14y *vs* 58±13y), had higher BMI (26.7±5.0kg/m^2 *vs* 25.8±4.3kg/m^2) and lower diet quality (9.9±2.0 *vs* 11.6±1.6), p<0.001 for all. There was a significant interaction between snacking and diet quality for BMI, p<0.001. Snacking frequency was not associated with BMI for those with a high diet quality (DQS>12). However, frequent snackers with low diet quality (DQS<10) had higher BMI versus non-snackers (difference; 1.07kg/m^2, p<0.01) (age-matched). Frequent snackers with high diet quality ate less unhealthy (crisps, fizzy drinks, sweets) and more healthy (fruits) snack foods compared to frequent snackers with low diet quality (p<0.001 for all).

Conclusions: High diet quality may negate the unfavourable relationship between snacking and bodyweight. However, further studies are needed to disentangle health effects of snacking events (frequency) from snacking quality (food) and dietary patterns.

Keywords: Snacking, Diet quality

Funding: ZOE Ltd

Conflict of Interest Disclosure: TDS, JW and GH are co-founders of ZOE Ltd (ZOE).

TDS and SEB are consultants to ZOE.

AM, JC and CH are employed by ZOE.

Other authors have no conflict of interest to declare.

OAB(T4)3-6

Impact of probiotic consumption under the weight loss program on gut microbiota composition

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Background and objectives: Obesity has been associated with structural and functional changes in the gut microbiota. Manipulatation with gut microbiota using probiotics have been shown to improve gut integrity, and restore the microbial shifts characteristic of obesity. Traditional probiotic products are fermented dairy products. Bryndza is a traditional Slovak fermented sheep's cheese. Most Bryndza microbiots are lactic acid bacteria. Therefore the aim of our study was to study the effect of short-term weight loss programs with Bryndza cheese consumption on the structure of the gut microbiota, and body composition in middle-aged women.

Methods: We conducted a randomized, controlled, 4-week intervention study involving 22 women with elevated body fat percentage (more than 25). Each participant individually received detailed instructions and advice on lifestyle changes, a personalized nutrition plan and a physical activity plan. Subjects were randomly assigned to a control or intervention group according to diet. The intervention group consisted of 13 participants whose diet contained 30 g of Bryndza cheese per day (WLPB). The control group consisted of nine participants without regular consumption of Bryndza cheese (WLP).

Results: Both interventions lead to a significant and favorable change of BMI (p<0.001), body fat (p<0.01), waist

circumference (p<0.01). Moreover, the relative abundance of *Erysipelotrichales* significantly increased in both groups. The higher abundance of order Erysipelotrichales was measured within the groups (WLPB-pre vs. WLPB-post; p=0.001; WLP-pre vs. WLP-post; p=0.027). Family Lachnospiraceae decreased in the WLPB group (p=0.006). However, the relative abundance of lactic acid bacteria (*Lactobacillales*, *Streptococcaceae*, *Lactococcus* and *Streptococcus*) significantly increased only in the WLPB group. Furthermore, short-chain fatty acid producers *Phascolarctobacterium* and *Butyricimonas* increased significantly in the WLPB group.

Conclusions: A short-term weight loss program combined with Bryndza cheese consumption improves body composition and increases the abundance of lactic acid bacteria and short-chain fatty acid producers in middle-aged women. Additional randomized placebo-controlled trials will help develop clinical guidelines for the use of probiotic therapy in obesity.

Research was supported by Grant No. APVV-17-0099 and VEGA Grant No. 2/0129/20 and VEGA 1/0260/21,

ITMS: 313011V344

Long-term strategic research on prevention, intervention and mechanisms of obesity

Keywords: obesity, gut microbiota, weight loss, probiotic therapy, fermented dairy product Bryndza

Conflict of Interest Disclosure: None

OAB(T4)3-7

Untargeted multi-platform metabolomics identifies prognostic biomarkers for weight loss success on a New Nordic Diet

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Background and objectives: Several randomized controlled trials have compared specific diets for treating overweight and obesity, but all have failed to provide an average efficacy above 10%. Consequently, different individuals will likely have success with different diets. The purpose of precision nutrition is to provide targeted diet plans for the individual or for groups with a similar metabolic profile. The current study aims to utilize explainable artificial intelligence to build a model that can predict whether a subject will have a successful weight loss eating a New Nordic diet and to understand the interaction within the model.

Methods: Ninety-one subjects completed a weight-loss study following a New Nordic diet for 26 weeks. Based on the subjects' weight loss during the intervention period, we classified the responder as having lost ≧5% of their initial body weight (n=46) and non-responders as having lost <2% of their initial body weight (n=21). Clinical baseline data were combined with baseline urine and plasma untargeted metabolomics data obtained from the two platforms nuclear magnetic resonance and liquid chromatography-mass spectrometry for better coverage of the metabolomes. The different metabolomics data sets were preprocessed individually and concatenated afterward, resulting in a final data set including 2766 features. We employed QLattice® to develop a predictive model of weight loss responders and non-responders. The QLattice® is a symbolic regression and a method within machine learning that attempts to explain a target variable Y by multiple input variables X using a mathematical expression containing a set of basic functions.

Results: Besides age (P=0.009; responders: 47.3±13.0 years vs. non-responders: 39.4±11.0 years), all other classical clinical baseline measures showed no difference. The final model contained two features, feature X and feature Y. The model can be described as logreg(−0.013×compX−0.048×compY+9.4). The model performed robustly from the training (ROC-AUC 0.88) to the test set (ROC-AUC 0.81).

Conclusions: From this study, we were able to identify a two-feature model that is able to predict whether a subject with overweight or obesity is likely to successfully achieve a weight loss by eating a New Nordic Diet.

Keywords: Precision nutrition, Obesity, Metabolomics, New Nordic Diet, Biomarkers

Conflict of Interest Disclosure: No conflict of interest.

OAB(T4)3-8

Association between body composition by deuterium oxide dilution technique and anthropometric measurement in neurologically impaired patients

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Background and objectives: Neurologically impaired (NI) pediatric patients are at risk of malnutrition which impacts their health and quality of life. Accurate nutrition assessment is important to guide appropriate nutritional support. There are some limitations in application of conventional nutrition assessment methods among NI patients. Determining body composition requires more complex equipments and cannot be routinely performed. This study was conducted to evaluate the associations between anthropometric parameters used in clinical practice and body composition assessed by deuterium (D^2O) dilution technique in NI patients.

Methods: This cross-sectional study enrolled severe NI patients (GMFCS IV-V) aged 1-20 years who were depended on home enteral nutrition for at least 3 months. After obtaining informed consent, baseline characteristics were recorded. Anthropometric measurements including weight, length, mid upper arm circumference (MUAC), and skinfold thickness (SFT) were performed. Weight and length were calculated to Z-score according to WHO growth standard. MUAC and SFT were used to calculated arm muscle area and body fat mass (FM) using predictive equation. Body composition is determined by D_2O

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

dilution technique (reference method) following the International Atomic Energy Agency (IAEA) protocol.

Results: Thirty patients (60% male) were enrolled. The mean (SD) age is 6.90 (4.08) years. One third of patients had BMI-for-age z-score between -2SD to 2SD. Body composition analysis shows mean percentage of total body water (TBW), FM and fat free mass (FFM) are 48.55% (11.00), 36.69% (14.79) and 62.82% (14.21), respectively. Mean percentage of FM from predictive equation is higher than reference method (mean difference 8.82% [4.75, 12.91]; p <0.001). Multivariate regression analysis shows that the factors associated with FM are age (β=0.1 [0.06,0.13]; p <0.001), BMI (β=1.07 [0.04, 1.74]; p =0.002), MUAC (β=-0.81 [-1.55,-0.07]; p <0.001), and triceps SFT (β=0.57 [0.17,0.96]; p <0.001). TBW is associated with age (β=0.07 [0.05, 0.10]; p <0.001) and MUAC (β=0.33 [0.10,0.56]; p =0.004).

Conclusion: Despite enteral nutrition support, most of the NI children were malnourished. Our study shows associations between some anthropometric parameters (including BMI, MUAC and SFT) with FM and TBW assessed by reference method. These findings should be further evaluated and applied to predict the body composition of NI patients in clinical practice.

Keywords: Body composition, Anthropometric measurement, Neurologically impaired patients, Home enteral feeding, Deuterium oxide dilution technique

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OAB(T4)3-9

Enhanced leptin-induced TFF3 expression and EGFR transactivation directs occurrence of neoplasia in stomach of dietary fat-induced obese mice.

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Background and objectives: Obesity is a risk factor for gastric malignancies and tumors. However, the occurrence and mechanisms of neoplasia induced by high-fat diet (HFD) remain unclear. We have reported that HFD induces excess gastric leptin and its signaling, resulting in intestinal metaplasia, precancerous lesions of the stomach. In this study, we investigated the effect of gastric leptin signaling in intestinal metaplasia to clarify the mechanism of gastric neoplasia by HFD ingestion.

Methods: C57BL/6J or gastrointestinal epithelial cell-specific leptin receptor (LepR) conditional knockout (T3b-LepR cKO) mice were fed a high-fat diet (HFD) or control diet. The mice were euthanized by isoflurane inhalation, followed by surgical removal of the tissues for analyses of pathological changes, mRNA and protein expressions. COS-7 cells were transfected with plasmids expressing LepR and EGFR. The cells were then stimulated in presence or absence of recombinant rleptin or rTFF3.

Results: HFD induced leptin signaling, which in turn, accelerates the pathogenesis in the gastric mucosa along with extopic TFF3 expression and EGFR transactivation with the activation of STAT3, Akt, and ERK1/2. T3b-LepR cKO mice exhibited a suppressed elevation of leptin, TFF3, and phosphorylated EGFR in the stomach. Leptin promoted TFF3 expression in LepR-transfected COS-7 cells via STAT3, ERK1/2, and Akt phosphorylation. Additionally, in the LepR and EGFR co-transfected cells, these proteins were phosphorylated to a greater degree than that in LepR-transfected COS-7 cells along with augmented EGFR transactivation. Leptin induced TFF3 expression was greatly suppressed by PI3K inhibitor, LY294002. Furthermore, exogenous TFF3 treatment strongly phosphorylated EGFR in the EGFR-transfected COS cells.

Conclusions: These data suggest a novel LepR-signaling pathway that transactivates EGFR and leads to TFF3 expression via PI3K-Akt signaling. Notably, this promotes neoplastic transformation in the stomach. Therefore, this study shed light on the identification of new therapeutic targets for the treatment of precancerous symptoms in stomach and colorectal cancer.

Conflict of Interest Disclosure: There are no conflicts of interest to declare.

Keywords: Leptin , High-fat diet, Stomach, TFF3, EGFR

OAB(T4)4-1

Reduction in anaemia through daily supplementation of Iron Folic Acid Supplementation for 90 days amongst rural adolescent girls in India

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Background and objectives: Anaemia is a major public health problem (40%) amongst adolescent girls in India. The current ongoing weekly iron folic acid (IFA) supplementation program has witnessed a slow decline in anaemia prevalence over the past decades. World Health Organization in 2016 recommended daily IFA supplementation containing 30-60 mg elemental iron for 3 consecutive months as a public health intervention in menstruating girls residing in high anaemia burden settings. Hence, the present study was conducted to understand the impact of daily IFA supplementation on anaemia amongst rural adolescent girls in India.

Methods: A community-based cluster-randomized trial was conducted and Baseline and the mid-term assessments were done using the cluster-sampling techniques. A total of 264 adolescent girls in the age group of 12–19 years with mild and moderate anaemia were selected from government schools of rural Ballabgarh block, Haryana, India. IFA Supplementation containing 60 mg elemental iron and 500mcg folic acid was administered daily under supervision for 90 days. Hemoglobin, serum ferritin, and vitamin B_{12} levels were assessed at baseline and endline.

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DOI: 10.1159/000530786

Results: A total of 62 adolescent girls completed 90 doses of daily supplementation. The hemoglobin status of 67.5% participants improved to normal, post intervention with mean hemoglobin increase of 1.6 ± 1.2 g/dL. Adolescent girls with moderate anaemia (1.8 ± 1.2 g/dL) had higher increase in the mean hemoglobin levels as compared to mild anemic participants (1.0 ± 0.8 g/dL). Moderate anaemia reduced in 50.5% girls, however, hemoglobin status did not improve in 21.9% girls. Ferritin levels increased by 18.8 ± 35.0 ng/mL and completely alleviated in all girls post intervention.

Conclusions: Daily supplementation of IFA for 90 days reduced the overall proportion of anaemia by 67.5% and eliminated iron deficiency. Considering the operational feasibility and the effectiveness of the intervention, daily supplementation of IFA containing 60 mg elemental iron and 500mcg folic acid may be an effective strategy to reduce anemia amongst adolescent girls.

Keywords: Anaemia, Haemoglobin, Iron, Folic Acid, Adolescent

Conflict of Interest Disclosure: Authors Declare No Conflict of Interest

Further Collaborators: No further collaborators

OAB(T4)4-2

Acceptability and efficacy of Fish Surimi peptide in moderately acute malnourished children: a randomized clinical trial

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Background & Objectives: Fish-Surimi-peptide, a low-cost long self-lived food-product from fish consisting of all essential-amino-acids, could be an attractive-alternative to supply fish-protein in children's diet. This study aimed to assess the acceptability and efficacy of Fish-Surimi-peptide in 2-5 years old children with moderate-acute-malnutrition (MAM).

Methods: In 34 MAM-children an acceptability study was completed by a randomly-blinded study with cross-over design. Children received Fish-Surimi-peptide (5g/lunch and 5g/supper) mixed meal in one day and the same meal on other day without any Fish-Surimi-peptide. We observed the completeness and eagerness of eating and any possible side effect. Following that, a pilot randomized intervention study was conducted in 75 MAM-children. Intervention group received two weeks' supply of Fish-Surimi-peptide @ 10g/day as take-home ration for three months. The control group received dietary advice in place of Fish-Surimi-peptide.

Results: In the acceptability-study 44% were female-children, their mean±SD age was 38.4±9.4 months and weight-for-height z-score (WHZ) was -2.13±0.76. Total feeding-time, amount of food eaten and number of food-refusals during lunch and supper together was found similar in Fish-Surimi added and non-added group respectively. Score in Hedonic scale (dislike extremely=0 to like extremely=5) by mother on test of food given to children was 3.9±0.2 vs. 4.0±0.2 (p=0.317) and on overall-acceptance (including the texture, smell, and appearance) of food was 3.9±0.2 vs. 4.0±0.2 (p=0.317) for Fish-Surimi added and non-added group respectively. No adverse event was observed in any group during the study period. All baseline characteristics of the children enrolled in efficacy-trial were similar between the intervention and control groups. On enrollment their mean±SD age was 38.4±9.5 vs. 37.1±10.8 months, and WHZ was -2.39±0.26 vs. -2.31±0.33. Over three months study period the improvement of anthropometric parameters was observed in positive trend in Fish-Surimi intervention group. Particularly, the height increment (cm) of 1.5±0.7 vs. 1.3±0.6 (p=0.042) and improvement of total protein (g/liter) of 2.87±5.28 vs. 0.26±4.12, p=0.038) were noticeable.

Conclusions: Fish-Surimi-peptide has been found to be a well-accepted safe supplementary food and showed a positive trend in the improvement of growth in Bangladeshi malnourished-children. This should be tested by larger randomized multicounty community level intervention-trial in undernourished or stunted children.

Keywords: fish surimi peptide, acceptability, efficacy, moderate acute malnutrition, under-5 children

Conflict of Interest Disclosure: No conflict of interest

OAB(T4)4-4

The Factors Associated to Severity Level in Women with Systemic Lupus Erythematosus at Indonesia Lupus Foundation

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Background and objectives: Systemic lupus erythematosis is a chronic inflammatory disease because of an immune system error that causes the immune system to attack the body's own tissues and organs. Seveity of systemic lupus erythematosis is divided into 3 levels, there is mild, moderate and severe, which is seen based on the severity - the symptoms that appear. Several causes of inflammation in systemic lupus erythematosis patients was eaten foods high in saturated fat, depression, and sleep quality. The aimed of this study is to analyze the correlation between saturated fatty acid intake, depression, and sleep quality with severity level of women with Systemic Lupus Erythematosis patients in Indonesia Lupus Foundation.

Methods: This study is a quantitative study using a cross-sectional design. The sample is women aged 15-45 years as many as 40 patients. The sampling technique in this study used

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

purposive sampling. The data used are primary data taken using the Mex–Sledai Questionnaire, Semi Quantitavtive - Food Frequency Questionnaire, Beck's Depression Inventory, and Pittsburgh Sleep Quality Index. Analysis of the correlation was done by using the chi square test.

Results: The results showed that 57.5% of the samples had severe conditions. Moreover, 78.2% of them had a high intake of saturated fat, 52.1% had moderate depression, and 95.6% had poor sleep quality. There is a relationship between saturated fat intake (p=0.039), depression (p=0.006), and sleep quality (p=0.000) with the severity level of the patient.

Conclusions: There was a significant correlation (p<0.05) between saturated fatty acid intake, depression, and sleep quality with severity level on systemic lupus erythematosus patients in Indonesia Lupus Foundation.

Keywords: Depression, saturated fatty acid intake, severity level of systemic lupus erythematosus, sleep quality

Conflict of Interest Disclosure: There is no conflict of interest in this study.

Further Collaborators: There is no further collaboration in this study.

OAB(T4)4-5

Effect of maternal dietary diversity during lactation on risk of atopic dermatitis via gut microbiome

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Background and objectives: The maternal diet during pregnancy and lactation plays an essential part in modulating the mother's intestinal flora from which it is transferred to the infant in many ways. In addition, current evidence supports that infant intestinal microbiota contributes to atopic dermatitis in early life. This study aimed to explore the prospective association between maternal diet diversity during lactation and the risk of atopic dermatitis through the gut microbiome in early childhood.

Methods: We included 60 mother-infant pairs from the Taipei Maternal Infant Nutrition Cohort Study, Taiwan from 2018 to 2021. Dietary diversity was assessed by using a 24 hours dietary recall method for 3 days during lactation and FAO's Minimum Dietary Diversity for Women index. Stool samples were collected from the infants at 2 months. Microbiota analyses were performed using 16S rRNA gene amplicon sequencing. Children's atopic dermatitis was assessed by pediatricians at 0, 4, and 12 months of age.

Results: Twenty-seven percent of women had low dietary diversity during lactation. Among 60 infants, the number of infants with atopic dermatitis at the time points 0 months, 4 months, and 12 months of age were 1, 3, and 8, respectively. During lactation, high or low maternal dietary diversity affected the alpha diversity of the infant's gut microbiome. Principal coordinate analysis ordination revealed that the infant gut microbiome clustered differently for high and low maternal dietary diversity during lactation (p<0.05). The linear discriminant analysis effect size and feature selection identified 5 and 6 taxa from both the low and high maternal dietary diversity groups. Among the 11 abundant taxa, we observed that two taxa have an association with the risk of atopic dermatitis among infants at 12 months of age, including *Eggerthellaceae* and *Clostridia_Family_XI* (p<0.05).

Conclusions: There were significant differences in the microbiota composition between infants from mothers who had high or low dietary diversity during lactation. Through two taxa of gut microbiomes of infants including *Eggerthellaceae* and *Clostridia_Family_XI*, maternal dietary diversity can potentially contribute to the risk of atopic dermatitis.

Keywords: maternal diet diversity, lactation, infant gut microbiome, infant atopic dermatitis

OAB(T4)4-6

Adherence to Dietary Quality Indices Is Associated with Lower Risk of Cardiovascular Disease risk factors and Graft Function Deterioration in Taiwanese Renal Transplant Recipients

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Background and objective: The Alternative Healthy Eating Index (AHEI) is used to examine dietary quality. The AHEI and its updated version, AHEI-2010, are based on the American Dietary Guidelines. AHEI-Taiwan was modified from AHEI according to Taiwan's dietary recommendations. This study is aimed to investigate the association between dietary quality indices and both cardiovascular disease (CVD) and chronic kidney disease (CKD) risk in renal transplant recipients (RTRs).

Methods: This prospective study recruited RTRs aged >18 years with a functioning allograft and without any acute rejection in the past 3 months from September 2016 to June 2018. Dietary quality indices were calculated using 3-day dietary records, and calculated scores were divided into quartiles. Laboratory data were collected from medical record; CKD was defined as an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m^2. Lipid profile include total cholesterol (TC), low lipoprotein cholesterol (LDL-C), high lipoprotein cholesterol and triglyceride were based on the National Cholesterol Education Program in Adult Treatment Panel III guidelines. Logistic regression analysis was performed to analyze the associations.

Results: This study included 102 RTRs. The RTRs with higher AHEI-Taiwan, and AHEI-2010 scores were older and had higher eGFRs; RTRs with higher AHEI-Taiwan scores had lower TC and LDL-C. After adjusted age, gender, energy intake and

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DOI: 10.1159/000530786

comorbidity index, the highest quartiles of the AHEI-Taiwan, and AHEI-2010 had 90% (odds ratio [OR] = 0.10; 95% confidence interval [CI] = 0.03–0.43, p < 0.01), and 85% (OR = 0.15; 95% CI = 0.04–0.57, p < 0.01) lower risk of CKD, respectively. The highest quartiles of the AHEI-Taiwan had 82% (OR = 0.18; CI = 0.05–0.71, p < 0.05) lower risk of high TC, and 89% (OR = 0.11; CI = 0.03–0.50, p < 0.01) lower risk of high LDL-C, respectively.

Conclusion: Healthy dietary quality, especially AHEI-Taiwan which based on Taiwanese dietary recommendation was associated with decreased risk of both CVD and CKD risk in the Taiwan RTRs.

Keywords: dietary quality, eating index, renal transplant recipients, chronic kidney disease, cardiovascular disease

OAB(T4)4-7

Nutritional risk index and risk factors for graft function in renal transplant patients

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Introduction and objectives: Poor nutritional status has been associated with worse clinical outcomes and heightened mortality in kidney transplant (KTx) recipients. However, the risk of malnutrition and graft function following KTx is unclear. The present study sought to determine the association between nutritional status and graft function and its risk factors among 12-month KTx patients.

Methods: A longitudinal study was conducted among 75 KTx recipients at a hospital in Vietnam. Anthropometric, hemoglobin, serum albumin, glucose, triglyceride, HDL and serum creatine were obtained on the discharge day (T0) and after 12 months post-transplant (T12). The risk of malnutrition was assessed by nutritional risk index score (NRI). Kidney function was evaluated based on the estimated glomerular filtration rate (eGFR).

Results: At T0, 68.9% of the patients had no risk of malnutrition (A), 29.5% had mild and moderate malnutrition (B), and 1.6% were severely malnourished (C). The distribution of nutritional status was significantly changed (McNemar test, p<0.05) after 12 months post-KTx to 85.1%, 15.9%, and 0% for categories A, B and C, respectively. Prevalence of anemia decreased significantly from 77.1% at T0 to 16.7% at T12 (McNemar test, p<0.001). Cox proportional hazards found anemia (HR 0.24, 95%CI 0.14 - 0.40), low albumin (HR 0.01, 95%CI 0.03 - 0.07), BMI (HR 0.86, 95%CI 0.77 - 0.97), and risk of malnutrition (HR 0.41, 95%CI 0.24 - 0.70) were associated with decreased eGFR, while blood level of tacrolimus (HR 1.22, 95%CI 1.11 - 1.33) was associated with increased eGFR. Multilinear regression model found that 34.2% of variance change in eGFR mean was explained by gender, white blood cells, anemia, risk of malnutrition and length of stay (R^2 0.342), whereby eGFR = 87.63 - 0.35 male + 0.21 white blood cell count (G/L) + 0.14 risk of malnutrition – 0.33 anemia – 0.32 length of stay (day).

Conclusion: Nutritional status improved significantly at 12 months post-transplant compared to the baseline. Several independent risk factors, including male, anemia, low albumin, risk of malnutrition, and length of stay, led to a decrease in kidney function. Providing nutrition counselling to improve these factors among transplant patients may reduce the risk and improve graft survival.

Keywords: Graft function, Nutritional Risk Index, Renal transplant, Vietnam

OAB(T4)5-1

Metabolic syndrome and plasma levels of amyloid-β, total-tau and neurofilament light chain: The Rotterdam study

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Background and objectives: Components of metabolic syndrome have been suggested to increase the risk of Alzheimer's disease (AD), but pathways underlying this remain incompletely understood. Plasma levels of amyloid-β (Aβ), total-tau and neurofilament light chain (NfL) reflect AD-associated neuropathological features: Plasma Aβ levels are increased in the early stages of AD, while decreased levels are seen in the prodromal AD phase due to deposition. Plasma levels of total-tau and NfL reflect axonal damage and are often elevated before AD onset. We investigated the association of the individual components of metabolic syndrome with circulating plasma levels of Aβ, total-tau and NfL.

Methods: Between 2002 and 2005, metabolic syndrome components and plasma Aβ-40, Aβ-42, total-tau and NfL levels were measured in 4,871 participants (mean age 72 years, 57% women) from the population-based Rotterdam Study. Components of metabolic syndrome included: waist circumference, fasting serum triglycerides, HDL cholesterol and glucose, and systolic and diastolic blood pressure. Associations between these components and AD-related plasma markers were determined using multiple linear regression models.

Results: Serum triglycerides were associated with higher $\log_2$ Aβ-42 plasma levels (mean difference per standard deviation (SD) increase [95% CI]: 0.03 [0.01;0.06]), whereas serum HDL cholesterol was linked to lower plasma levels of $\log_2$ Aβ-40 (mean difference per SD increase [95% CI]: -0.06 [-0.08;-0.03]). No link was observed for other components of metabolic syndrome with Aβ-40 or Aβ-42. Waist circumference was associated with higher $\log_2$ total-tau and lower $\log_2$NfL plasma levels (mean difference per SD increase [95% (CI)]: 0.08 [0.04;0.11] for total-tau and -0.18 [-0.21;-0.16] for NfL). Systolic blood pressure was linked to higher $\log_2$ NfL plasma levels (mean difference per SD increase [95% CI]: 0.05 [0.02;0.08]), while

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

diastolic blood pressure was associated with lower log_2 plasma levels of total-tau and NfL (mean difference per SD increase [95% CI]: -0.04 [0.08;-0.01], for total-tau and -0.04 [-0.07;-0.02] for NfL). Other components of metabolic syndrome were not associated with total-tau or NfL.

Conclusions: Our findings suggest a link of serum triglycerides and HDL cholesterol with plasma levels of Aβ, while abdominal fat and blood pressure may contribute to the risk of AD though axonal damage.

Keywords: Metabolic syndrome, Alzheimer's disease, Plasma biomarkers, Amyloid-β, Population-based

Conflict of Interest Disclosure: None

Further Collaborators: Not applicable

OAB(T4)5-2

Recurrent Western dieting alters brain homeostasis and regulation of food intake via persistent changes in the gut microbiota–host symbiosis

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Background and objectives: Alternating periods of excessive and restrained eating, a dieting behavior that also occurs in normal weight individuals, is a risk factor for the development of excess weight gain and food intake dysregulation such as binge eating. We tested the hypothesis that recurrent exposure to palatable food (HFS) alters food intake regulation by changing either or both intestinal microbiota and brain homeostasis in mouse.

Methods: C57BL/6 mice underwent 3 cycles of 1 week of HFS (45% kcal from fat and 18% from sucrose) exposure separated by 2 weeks of chow diet exposure (CYCL group) or staid under chow diet (CTRL group). Food intake was precisely monitored after each dietary change to identify potential binge eating episodes as well as daily with body weight. Expression levels of inflammation- and reward-related genes were evaluated in the striatum, hypothalamus and brainstem before the 3rd HFS introduction and in CTRL mice. Cecal samples were collected to analyze microbiota composition through 16S DNA sequencing. Then, cecal samples from CYCL and CTRL mice were transplanted into naive recipient mice kept on chow diet or submitted to HFS to investigate whether differences in food intake behavior and central markers of inflammation and reward could be transmitted via the gut microbiota.

Results: Recurrent HFS exposures increased energy intake specifically during the first hours following HFS re-introduction. Inflammatory state in brain areas involved in food intake regulation was lower after recurrent exposure to HFS, either under chow or in response to HFS, while expression of reward-related genes was enhanced. Recurrent exposures to HFS induced changes in gut microbiota composition and metabolic activities which persisted even after the mice had returned to standard chow diet. Gut microbiota transfer from CYCL mice to naive recipient mice changed their feeding behavior on HFS, which becomes very similar to that of donor mice.

Conclusions: Our data demonstrate that altered gut microbiota contributes to the escalating consumption of palatable diet in the context of recurrent exposure to HFS. Worse still, altered gut microbiota likely participates to the relapse into overeating during dietary management of obesity, and likely explains failure in the obesity therapy.

Keywords: microbiota, reward, obesity, inflammation

Conflict of Interest Disclosure: No conflict of interest

OAB(T4)5-3

Nutrient-dense vegan food for dysphagia patients using 3D printing

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Background and objective: Dysphagia is a common problem in the elderly. And this is of particular significance in Japan, which has the world's largest elderly population. Dysphagia can lead to significant malnutrition and dehydration because it interferes with the voluntary process of safe feeding. To combat malnutrition caused by this illness, palatable meals with a pleasing texture that can also be easily swallowed must be created. 3D food printing is a potentially useful method for generating safe and high-quality food with established applications. Current research aims to explore the effect of 3D printing parameter settings and the very nutritious chia seed flour on the production of commercially viable transitional plant-based protein foods.

Methods: Pretreated horse gram flour and chia (Salvia hispanica L.) seed flour were blended in different combinations to produce 3D printable formulations with varying functionalities. The rheological behavior of the printing features of the composite formulations was investigated, as were the textural, functional, and morphological properties of the 3D printed structures. Moreover, the IDDSI tests for Level 6 and 7 dysgraphia food were performed to evaluate the 3D printed products for commercial viability, and the results were validated with instrumental analytical results.

Results: Analyzing the effect of chia seed flour addition and printing parameters revealed that 10% CSF incorporation, 0.8 mm nozzle diameter, 12 mm/s printing speed, 0.6 mm layer height, and 25% infill produce desirable 3D printed constructs in terms of better shape accuracy with and good stability. Furthermore, these conditions were conducive to the creation of 3D printed structures with decreased hardness and increased cohesion, which is desirable in dysphagia foods. In addition,

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DOI: 10.1159/000530786

using a combination of microwave heating and freeze drying to post-process these 3D structures resulted in a more appealing texture and 3D printed transitional food.

Conclusions: The findings of the printing performance, texture profile, and IDDSI tests revealed that the addition of CSF acted as a unique textural modifier and flow enhancer. The printing accuracy and post-printing stability of the constructs were impacted by the extrusion rate. As a result, our research paves the path for the use of CSF as a novel functional hydrocolloid in the development of nutrient-dense vegan transitional dysphagia food.

Keywords: 3D food printing, food texture, plant-based protein, dysphagia, IDDSI tests

Conflict of Interest Disclosure: There is no conflict of interest to declare.

OAB(T4)5-4

Longer-term mixed nut consumption improves brain and peripheral vascular function, and memory: Results of a randomized, controlled crossover trial in older adults.

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Background and objectives: Effects on vascular function may contribute to the beneficial effects of nut consumption on age-related cognitive decline. Therefore, we examined the longer-term effects of mixed nuts on both brain and peripheral vascular function that may underlie cognitive benefits among older adults.

Methods: Twenty-eight healthy individuals (age: 65±3 years; BMI: 27.9±2.3 kg/m^2) were included in a randomized, single-blinded, cross-over trial with a 16-week intervention (60 g/d mixed nuts: 15 g of walnuts, pistachio, cashew, and hazelnuts) and control period (no nuts), separated by an 8-week wash-out period. Participants followed the Dutch food-based dietary guidelines. At the end of each period, cerebral blood flow (CBF) - a marker of brain vascular function - was quantified using arterial spin labeling MRI, while peripheral vascular function was assessed by using validated markers of endothelial function, arterial stiffness, and microvascular structure. Furthermore, cognitive performance was assessed in the domains of memory, executive function, and psychomotor speed.

Results: Body weight and composition did not change during the whole study. Regional CBF was higher in three brain clusters that were located in the right frontal and parietal lobe (Δ5.0±6.5 mL/100g/min; P<0.001), left frontal lobe (Δ5.4±7.1 mL/100g/min; P<0.001), and bilateral prefrontal cortex (Δ5.6±6.6 mL/100g/min; P<0.001). Mixed nut consumption also improved endothelial function as the carotid artery response to a cold pressor test (Δ0.7 PP; 95%CI: 0.2 to 1.2; P=0.007) and brachial-artery flow-mediated vasodilation (Δ1.6 PP; 95%CI: 1.0 to 2.2; P<0.001) were higher. Furthermore, beneficial effects were observed on arterial stiffness and microvascular function, as the carotid-to-femoral pulse wave velocity was lower (Δ-0.6 m/s; 95%CI: -1.1 to -0.1; P=0.032) and retinal arteriolar calibers were higher (Δ2 µm; 95%CI: 0 to 3; P=0.037). Finally, memory was beneficially affected given the improved performance on the paired association learning (Δ-4 errors; 95%CI: -8 to 0; P=0.045) and verbal word recognition (Δ1 correct; 95%CI: 0 to 2; P=0.035) tasks. However, psychomotor speed and executive function did not change.

Conclusions: Longer-term mixed nut consumption on top of a recommended diet significantly improved both brain and peripheral vascular function, which may underlie observed beneficial effects on cognitive performance in older adults.

Keywords: Nuts, Brain, Vascular Function, Cerebral Blood Flow, Cognitive Performance

Conflict of Interest Disclosure: None.

Further Collaborators: This study was supported by a grant from the International Nuts and Dried Fruit Council (INC) but they were not involved in the design, implementation, analysis, and interpretation of the study.

OAB(T4)5-5

Dietary intake, malnutrition and hospital readmission among old adults; Randomized controlled intervention

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Background and objectives: Protein energy malnutrition (PEM) among older adults is undeniably a challenging problem as the world population ages. PEM refers to a nutritional deficiency that is commonly due to inadequate dietary intake among older adults, which has often been associated with age- or disease-related changes such as reduced appetite, physical mobility, and/or acute illness. Specific aims were 1) to explore the differences in dietary intake between the groups which received either 6-month multi-component nutrition therapy or standard care after hospital discharge, 2) to determine the prevalence of PEM according to the Global Leadership Initiative on Malnutrition (GLIM) criteria after discharge, 3) to investigate if 6-month-multi component nutrition therapy impacts hospital readmission and, or length of stay.

Methods: The HOMEFOOD study is a 6-month randomized controlled intervention. Total participants were 104 patients, aged 65 years or older at risk for malnutrition or malnourished according to nutritional screening and discharging from the hospital to independent living. Dietary intake at baseline (day before the discharge from the hospital), after 3-months and at 6-months was assessed using a 24-hour-dietary-recall interview. The prevalence of PEM was determined according to GLIM

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

criteria at baseline and after 6 months. Data on hospital readmissions and length of stay among participants were obtained from the Icelandic electronic hospital registry (SAGA).

Results: Energy and protein intake 3- and 6 months after hospital discharge were significantly higher in the intervention group ($p<0.001$, $p<0.001$, respectively). At baseline 30 (58%) patients in the control group and 34 (65%) patients in the intervention group were malnourished according to GLIM criteria. However, 6 months after discharge, 9 participants (17%) were malnourished in the intervention group according to GLIM criteria, compared to 38 participants (73%) in the control group. 6-month multi-component nutrition therapy did not have any impact on hospital readmission and/or length of stay.

Conclusions: 6-month-multi-component nutrition therapy impacts energy- and protein intake and decrease risk of malnourishment according to GLIM criteria. However, 6-month multi-component nutrition therapy does not affect hospital readmission and/or length of stay.

Keywords: Malnutrition, GLIM, old adult, randomized controlled intervention

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T4)5-6

Lifestyle-based risk prediction models for colorectal cancer in a European population: a systematic review and meta-analyses

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Background: Colorectal cancer (CRC) is the second leading prevalent cancer in Europe, of which one-fifth is attributable to unhealthy lifestyle, including high body mass index (BMI). Risk models identifying high-risk groups based on lifestyle may support improved prevention through motivating lifestyle change.

Objectives: To provide an overview of risk models of primary CRC based on lifestyle data and developed and/or validated for a European population, including a summary of the effect size of common lifestyle factors.

Methods: A systematic review was conducted in PubMed and Web of Science. Included were risk models for CRC (i) based on lifestyle, (ii) developed and/or validated in an adult asymptomatic European population, (iii) reported the estimates with uncertainty measure for the predictors included. The model-specific effect sizes of lifestyle factors included in at least five risk models were summarized into a weighted average and 95% confidence interval (CI) using inverse-variance random-effects meta-analyses.

Results: A total of 17 risk models for CRC (reported in 12 studies) were eligible, of which nine were validated in an European population but developed elsewhere, mostly US. Pooled effect sizes for common lifestyle factors were found to be of similar strength, with for ever smoker a pooled RR of 1.22 (95%CI: 1.15, 1.29), for high alcohol consumption of 1.14 (95%CI: 1.08, 1.20), and for being physically active of 0.87 (95%CI: 0.82, 0.93), and for BMI of 1.13 (95%CI: 1.10, 1.16) for overweight and of 1.32 (95%CI: 1.20, 1.44) for obesity, based on twelve, nine, six, eight and ten, respectively, model-specific effect sizes. Diet-related lifestyle predictors were: consumption of meat (with two models total, two red and two processed meat) and vegetables (four models), amongst others: dairy and multivitamins (each in two models), and calcium, sugar and confectionary and dark bread (each in one model).

Conclusions: Lifestyle was identified as a significant predictor in multiple risk prediction models for CRC. Early identification of high-risk groups based on lifestyle data would therefore offer the potential to encourage participation in lifestyle and screening programmes, and subsequently reduce the CRC burden.

Keywords: colorectal cancer, risk prediction, Europe

Conflict of Interest Disclosure: None

Further Collaborators: Not applicable.

OAB(T4)5-7

Dietary patterns underlying biological mechanisms and breast cancer survival: Evidence from a prospective cohort study

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Background and objectives: A number of dietary patterns have recently emerged in nutritional research aimed at assessing the biological mechanisms underlying diet-cancer associations, probably due to synergistic or additive effects of dietary components. In part, because of advances in treatment, the number of breast cancer survivors has increased, and they may not die from the disease but from other causes. We aimed to examine associations between pre-diagnosis dietary patterns underlying biological mechanisms presumably related to breast carcinogenesis (insulin-resistance, low-grade chronic inflammation, and estrogen metabolism) and breast cancer survival.

Methods: The diabetes risk reduction diet [DRRD], the inflammatory score of diet [ISD], and the estrogen-related dietary pattern [ERDP], were calculated using dietary data from the European Prospective Investigation into Cancer and Nutrition (EPIC) study. We examined the associations between these patterns and overall and specific mortality among 13,270 breast cancer survivors during a mean follow-up of 8 years. Adjusted Cox regression analyses were used to estimate the association between dietary patterns and overall mortality, and

the associations with breast cancer-specific mortality were based on competing risk models.

Results: Adherence to DRRD score was associated with 22% lower overall mortality (HR HR_{Q4vsQ1}=0.78; 95%CI 0.68-0.90) and an 8% decrease per one standard deviation increase in the score (HR=0.92; 95%CI 0.87-0.96). High DRRD score (low-risk diet for diabetes) combined with low ISD (anti-inflammatory diet) using the median as cut-off points to dichotomise each score, was associated with lower overall mortality (HR=0.83; 95%CI 0.73-0.93) compared to low-DRRD-high-ISD (high-risk diet for diabetes, pro-inflammatory diet). The ERDP did not show a clear association with mortality. None of the dietary patterns were associated with breast cancer-specific mortality. Higher DRRD and higher ISD were inversely and positively associated, respectively, with mortality among postmenopausal breast cancer cases, those presenting healthy weight, physically inactive, and with progesterone receptor-positive (PR+) tumours, despite no significant heterogeneity by subgroups.

Conclusions: Greater adherence to DRRD score, corresponding with a low-insulin-resistance diet, was associated with better overall survival among breast cancer survivors. This effect was more pronounced in combination with anti-inflammatory diet, suggesting that following these dietary patterns pre-diagnosis may be important for breast cancer survivors.

Keywords: dietary pattern, breast cancer, cancer prognosis, cancer survival, prospective study

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OAB(T4)6-1

Undetected hypertension: prevalence and association with age, gender and dietary pattern among healthy urban adults in Delhi

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Background and Objective: High blood pressure is a classical feature of the cardiometabolic syndrome and it is seen that almost one-third of hypertensive patients have metabolic syndrome. It is reported that as high as 50% of the people with diabetes remain undetected in India. The present study was planned to assess the prevalence of undetected hypertension among apparently healthy urban adults and its association with gender, age and dietary pattern.

Methods: The study was conducted among 400 healthy urban adults comprising of 200 vegetarians (VS) and 200 non-vegetarian subjects (NVS) as per the operational definitions for the present study. SBP and DBP measurements were taken using a digital OMRON Blood Pressure Monitor (HEM:8712 OMRON Corporation, Japan). Hypertension was defined based on JNC 7(2003) defining criteria.Data on the socio-demographic profile, anthropometric measurements, were collected using standardized tools and techniques. Data were analyzed using SPSS version 25.

Results: The study results highlight that 26.75% were hypertensives and 46.5% of the subjects were found to be prehypertensives thus highlighting the substantial burden of undiagnosed hypertension. The prevalence of undiagnosed hypertension was 27.97% and 25.6% among males and females respectively. Considering the dietary pattern, it was seen that non-vegetarian males (NVM) had a significantly higher prevalence of undiagnosed hypertension (34%) than vegetarian males (VM,21.9%, p=0.001*). Almost an equal number of vegetarian females (VF) and non-vegetarian females (NVF) were noted to be hypertensives (26% and 25.2% respectively, p=0.271). The prevalence of hypertension was significantly higher among the subjects who were >45 years (34.28%) of age than those less than 45 years (22.69%, p =0.002*). Results of multiple regression analysis depicted that SBP was significantly associated with age (**p=0.001*), gender (p=0.017*) and diet (p=0.024*) while there were no significant associations found between DBP with these variables.**

Conclusion: The study highlights the importance of timely screening of the population to prevent and manage hypertension efficiently and prevent further complications related to elevated blood pressure

Keywords: Hypertension, vegetarian diets, undetected Hypertension, pre hypertension, prevalence

Conflict of Interest Disclosure: Nil

Further Collaborators: Nil

OAB(T4)6-3

Personalised dietary advice delivered using a metabotype approach improves lipid profile: a randomized controlled trial

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Background and objectives: Metabotypes are groups of individuals with similarities in their metabolic profile and have been associated with diet-related diseases and responses to dietary interventions. However, its effectiveness to deliver personalised dietary advice has not been tested in an intervention. Our previous work developed a framework to deliver personalised dietary advice based on metabotypes, with individuals being classified using four biomarkers (triacylglycerol, HDL-cholesterol, total cholesterol, glucose). The objective of this study is to examine the effectiveness of the metabotype approach at improving metabolic health biomarkers compared to population-level dietary advice.

Methods: A randomized single-blind controlled trial was performed with 107 healthy adults (Ethics approval LS-19-98-Brennan). Participants received dietary advice based on the metabotype approach or generic healthy eating guidelines.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Blood biomarkers, anthropometry and blood pressure were assessed pre and post 12-week intervention. Targeted metabolomic analysis of plasma was performed using UHPLC-MS/MS. One-way analysis of variance was performed on metabolomic data at baseline to assess differences across metabotypes. Comparison between study groups post-intervention was performed on an intention-to-treat basis by general linear models adjusted for measurement at baseline.

Results: Following the intervention, individuals receiving advice based on their metabotype group had significantly lower concentrations of triacylglycerol (0.5±0.4 vs 0.7±0.6 mmol/L), total cholesterol (4.9±1.0 vs 5.5±1.3 mmol/L) and LDL-cholesterol (3.8±1.1 vs 4.2±1.3 mmol/L) compared to the control group (all $p<0.05$ between groups). No significance was observed for anthropometry, blood pressure and glucose. Examination of the metabotypes revealed distinct metabolic profiles for each metabotype as baseline. Metabotype 3 was characterised by the highest mean total cholesterol (5.7±1.0 mmol/L), triacylglycerol (1.2±0.5 mmol/L) and glucose (4.9±0.5 mmol/L) and the highest levels of leucine and isoleucine (branched-chain amino acids) and a-aminoadipic acid (FDR<0.05). Metabotype 1 had the highest mean HDL-cholesterol (2.2±0.4 mmol/L). Metabotype 2 had the lowest mean total cholesterol (4.4±0.9 mmol/L) and the lowest levels of phosphatidylcholines and sphingomyelins.

Conclusions: Our metabotype approach classifies individuals into distinct and meaningful metabolic profiles. Personalised dietary advice delivered using the metabotype approach is more effective than population-level dietary advice at improving metabolic health biomarkers, in particular their lipid profile. Future analysis will elucidate changes in diet quality.

Keywords: metabotypes, biomarkers, cluster analysis, personalised nutrition, clinical trial

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OAB(T4)6-4

Temporal trend of macronutrient intakes and physical activity level among lipid-lowering medication users and nonusers in the US: NHANES 2007-2018

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Background and objectives: Previous studies indicated a clear benefit of saturated fat intake reduction and regular physical activity in decreasing cardiovascular disease (CVD) risk. Statin use is also an approach to reducing CVD risk. While statin prescription substantially increased over time, the adherence to healthful lifestyle habits may be suboptimal. We examined the temporal trend of macronutrient intakes and physical activity level among lipid-lowering medication (LLM) users and non-users in the U.S.

Methods: We used data on non-pregnant adult participants aged 40 years or older at the time of enrollment in the National Health and Nutrition Examination Survey (NHANES) 2007-2018. We divided participants into three groups: no dyslipidemia (non-DLP), non-users with dyslipidemia (non-LLM), and LLM users (LLM). To estimate the nutrient intakes in each survey cycle, we fitted generalized linear models with log-link function and gamma distribution, treating nutrient intakes as a continuous outcome variable, with adjustment for age category, gender, race/ethnicity, education level, poverty, and diabetes mellitus. The models included survey cycle to evaluate the temporal trend of the nutrient intakes. Also, temporal trends in the proportion of individuals meeting the recommended level of physical activity were examined in the three groups using logistic regression.

Results: Among 20,417 eligible participants, 28.4% were LLM users and 21.6% were non-users with dyslipidemia. Total caloric intake showed an increasing trend among the LLM group. Total fat and saturated fat intake showed an increasing trend in all three groups mainly for more recent years. The proportion of individuals meeting the recommended physical activity level increased in the non-DLP group while such trend was absent in the LLM and non-LLM groups.

Conclusions: LLM users showed a trend of increasing total caloric and fat intake in more recent years, which may be concerning. The proportion of physically active individuals increased over time in the non-DLP group only. More efforts are needed to improve the lifestyle habits of LLM users.

Keywords: macronutrient, physical activity, lipid-lowering medication, temporal trend

Conflict of Interest Disclosure: None.

OAB(T4)6-5

Effect of milk and soy milk consumption on blood lipids and blood calcium concentration among individuals with metabolic syndrome

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Metabolic syndrome is a group of interconnected metabolic risk factors that increase the risk for developing cardiovascular disease, type 2 diabetes, obesity, and all-cause mortality. Some studies have shown that consuming soy product could decrease lipid profile since soy contains beneficial components such as isoflavones, polyphenols, and other phytonutrients. The current study aimed to comprehensively evaluate the potential effects of milk and soy milk consumption on cardiometabolic risk factors and blood calcium concentration on metabolic syndrome adults. Seventy participants with metabolic syndrome were randomized in 4 groups: group 1 received cow milk daily, group 2 soy milk with milk powder, group 3 high calcium soy milk, plain, no sugar added, and group 4 high calcium soy milk, multigrain, no sugar added. Groups 1

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

and 2 consumed 500 ml of milk daily, while groups 3 and 4 consumed 460 ml of milk daily. Milk and soy milk were consumed twice daily 15-30 minutes before breakfast and dinner for 8 weeks. Blood serum lipid and blood calcium concentration was determined at weeks 0, 4 and 8. One way repeated measures ANOVA and Friedman two-way analysis of variance were used to analyze the differences within each group. One way ANOVA and Kruskal-Wallis test were used to analyze the differences between groups, and statistical significance was defined at p-value <0.05. The results of within-group comparisons revealed that all 4 types of milk significantly raised HDL-cholesterol at week 8. For soy milk with milk powder and high calcium soy milk, plain, no sugar added, significantly reduced LDL- cholesterol. The between-group comparisons showed that LDL-cholesterol for the high calcium soy milk, plain, no sugar added group was significantly lower those for that in the cow milk and high calcium soy milk, multigrain, no sugar added group. Blood calcium concentration was significantly increased in all groups except soy milk with milk powder group. Therefore, consuming cow and soy milk and could improve serum lipid profile and blood calcium concentration.

Keywords: Cow milk, Soy milk, Blood lipids, Blood calcium concentration

Conflict of Interest Disclosure: -

Further Collaborators: -

OAB(T4)6-6

Human DNA methylation trajectories of the postprandial metabolic response to food

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Background and objectives: Diet and postprandial markers of metabolic flexibility are major determinants of cardiometabolic health. The postprandial response is highly individualised, and molecular mechanisms underlying this variability are not well characterised. DNA methylation (DNAm) is a key regulator of gene function with potential to modulate the personalised metabolic responses after food intake. Within the JPI-DIMENSION consortium, we characterised human DNAm changes over the postprandial response, and explore their impacts on genes linked to metabolism and disease.

Methods: We profiled whole blood DNAm using the Infinium MethylationEPIC Kit in 360 samples from 120 individuals in the PREDICT1 study of postprandial metabolic responses in healthy individuals. Samples were profiled at baseline and after food intake, comparing changes in DNAm from fasting state (t_0) to peak glycemia (t_{30m}), and to peak lipemia (t_{4h}). Changes specific to peak lipemia were also explored in the baseline postprandial phase of the CORDIOPREV study, a randomized clinical trial involving patients with coronary disease. We profiled DNAm in 300 samples from 150 CORDIOPREV individuals at fasting and 4h. Changes in DNAm trajectory postprandially were tested in both samples at >756,000 CpG-sites genome-wide, using linear mixed-effects models adjusted for sex, age, BMI, smoking, blood cell composition, technical covariates, and family structure. Results are presented after multiple testing correction (FDR=10%).

Results: Overall, 19 differentially methylated positions (DMPs) showed postprandial trajectory changes in PREDICT1. The peak signal was in the *CAMTA1*ge ne, with decreased methylation at 30m after test meal (cg23021268; *b*=0.311±0.050, *p*=2.40E-08). PREDICT1 and CORVIOPREV meta-analysis identified 125 DMPs across 94 genes that changed postprandially at 4h, including in the cholesterol efflux gene *ABCG1*(cg27518648: *b*=0.078±0.016, *p*=1.11E-06). Pathway analysis identified enrichment in the PKA pathway, as well as in pathways of cardiac and metabolic signalling. Ongoing analysis include sex-specific components and transcriptomic profiling of 50 individuals of the PREDICT1 sample which link specific expression changes to DNAm trajectories.

Conclusions: In summary, we observe significant changes in DNAm levels at target genomic regions postprandially. Signals include both changes at peak glycemia and peak lipemia, and target metabolically relevant genes, with insights towards mechanisms mediating inter-individual variation in response to food.

Conflict of Interest Disclosure: Sarah Berry is a consultant for Zoe Global Ltd (associated with the PREDICT1 study).

Keywords: nutriepigenomics, cardiometabolic health, DNA methylation

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OAB(T4)6-7

Nutrition and lifestyle behavioural changes in metabolic syndrome: Experience from a peer-led community-based intervention in Malaysia

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Background and objectives: Peer-led programs benefit people with chronic diseases such as metabolic syndrome (MetS), which requires long-term intervention and social support. However, there is a lack of evidence on a peer-led behavioural change program to address the growing prevalence of MetS among Malaysians. This study aimed to develop a structured peer-led intervention for Malaysians with MetS addressing nutrition and lifestyle behavioural risk factors.

Methods: The study was conducted in three phases. Phase 1 included evidence synthesis and a cross-sectional study to identify modifiable risk factors for MetS in this population.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Subsequent Phase 2 focused on developing the community-specific peer-led intervention (PERSUADE), and the feasibility of PERSUADE was assessed in the third phase.

Results: The overall prevalence of MetS was 32.2% (*N*=481). Low physical activity (OR=4.76, 95%CI=1.49-15.26) and quick finishing of meals (OR=2.17, 95%CI=1.02-4.60) were mostly associated with increased odds of MetS. These findings and the outcomes of evidence synthesis were amalgamated with existing guidelines to result in a 12-weeks PERSUADE program. Four peer groups comprising 48 peers (median age=46 years) participated in PERSUADE. Although there were significant overall increases in total carbohydrate intake and glycemic load (both p <0.001), we noted significant reductions in the intakes of total energy and fat (both p <0.001). Physical activity (total METS/week) also showed a significant improvement (p <0.001). Overall, significant but marginal improvements in anthropometric and vital metabolic parameters were observed. More than 81% of the peers attended all sessions, with high satisfaction with the content (93.3%). More than two-thirds of the peers were satisfied with peer leadership. Content satisfaction was correlated with reduction in body fat content (r=0.348, p=0.015) and triglyceride (r=0.431, p=0.002). Peer leadership, however, was only correlated with a reduction in triglyceride (r=0.363, p=0.011).

Conclusions: This was the first of such efforts to develop and test the feasibility of a community-based peer-led intervention for MetS in the country. PERSUADE supported the adoption of the peer-based framework though there is a need to assess the long-term impact of such interventions in local community settings. Findings from this study also set the direction for other researchers to develop various other intervention models in Malaysia.

Keywords: metabolic syndrome, peer-support, community intervention, behavioural change

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T5)1-1

Effects of video-based health education on birth outcomes and anemia status of mothers in Dirashe District South Ethiopia: cluster randomized controlled trial

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Background and objective: Maternal undernutrition during pregnancy is associated with poor birth outcomes. Guidelines on recommended nutritional and health practices are designed and implemented in low and middle income countries through perinatal community services. However, coverage and adherence are suboptimal. Behavior change communication (BCC) during pregnancy using videos can overcome the limitations of coherence of messages delivered by the health extension workers (HEW) and might increase the coverage of- and the adherence to the video-based BCC. This study aims to assess the effects of video-based BCC on anemia status of pregnant women and birth outcomes.

Methods: This cluster randomized controlled trial was conducted in rural communities of Dirashe District, Southern Ethiopia. **Pregnant women** from 16 communities were included in their first trimester (n=596) and were assigned to receive either standard BCC messages by HEW (Control, eight communities) or via videos projected at the household during the six-month intervention till delivery (VideoHealth). There were ten videos covering maternal and infant nutrition and health. Groups were compared for birth outcomes and maternal anemia using analysis of co-variance.

Results: At baseline, women were (mean ± SD) 25.1±5.4 years of age, 46.3% did not have any formal education and 6.7% had hemoglobin concentration (Hb) < 11.0 g/dL. From all pregnancies, 6.2%, 2.2% and 17.9% ended in miscarriage, preterm birth and still birth respectively. Maternal Hb near delivery was12.9±0.06 g/dL and 13.1±0.07 g/dL in Control and VideoHealth groups, respectively (p=0.003). Mean birth weight was 3004 ±440 g in Control group and 3191±490 g in VideoHealth group (p=0.027). One-in-five women used maternity waiting homes and 70.6% of births were attended by skilled health personnel in the VideoHealth group *vs.* one-in-ten (p=0.002) and 50.2% (p=0.001) in the Control group.

Conclusions and Implications: Video-based BCC improved the utilization of maternity waiting homes and institutional delivery. It has also significantly increased birth weight and maternal Hb near delivery. Additional analyses will assess the effectiveness of the intervention to increase adherence to the recommended care during pregnancy.

Keywords: anemia, birth outcome, video-based education, maternal health service, Ethiopia

Conflict of Interest Disclosure: Authors declare that there is no conflict of interest

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OAB(T5)1-2

Effect of maternal mentoring program on improving iron and folic acid intake among Indonesian pregnant women: cluster randomized trial

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Background and objectives: Anemia is major nutritional problem in Indonesia. Based on Indonesian Basic Health Survey 2018 the prevalence of pregnancy anemia is 48,9%. The mentoring program for mothers that has been carried out since

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

the preconception period is expected to improve the iron status of the mother during pregnancy. The present study aims to determine the effect of a mentoring program since preconception period on the iron and folic acid intake among pregnant women in Bantul, Indonesia.

Methods: This cluster randomized controlled trial was conducted in Sedayu, Pleret, and Pajangan subdistricts of the Bantul District. A total of 128 clusters divided into 61 clusters per treatment arm. At the baseline, there were 322 samples, of which 205 were later confirmed pregnant and 194 were admitted to the end of the study. The intervention group received mentoring program, while the control group only received usual services from the Public Health Center. The mentoring program consist of health education, monitoring, and text-messages reminder. Mentoring was carried out from the preconception period, then followed up to 12 weeks of gestation. Iron and folic acid intake were measured twice, in the preconception period and between 13-16 weeks of gestation by using Semi Quantitative Food Frequency Questionnaire. Statistical test using T-test and Mann-Whitney test, with statistical significance at α=0.05.

Results: The results showed that in the intervention group, the mean intake of iron increased by 1.64 mg/day (p=0.001) while folic acid intake increased by 39.48 mcg/day (p=0.003). At the cluster level, respondents in the intervention group on average consumed 10 iron tablets more than the control group, but the difference was not statistically significant (34,57±15,11 vs 24,13±13,42; p=0,069).

Conclusions: Mentoring program since the preconception period can have positive impact on the iron and folic acid intake in pregnancy. This program can be suggested to be implemented in the other areas that still need improvement in iron and folic acid consumption.

Keywords: preconception care, pregnancy, supplementation, nutrition

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T5)1-3

Learning to respond to social norms to improve maternal and child nutrition

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Background and objectives: Food choices and child feeding practices are deeply embedded in gender, social and cultural norms. These social norms influence the meaning and value of food, as well as roles and expectations for each person.

Through this session, participants will do the following: Identify social norms relevant to behaviors to improve women's and children's diets.

Summarize evidence on effectiveness of social norms-focused interventions on nutrition outcomes.

Describe approaches to foster social norms that support recommended nutrition outcomes.

Access resources to understand and respond to social norms.

Methods: A systematic review collected what is known about social norms and nutrition and then identified gaps and implications for program and research on social norms and women's diets. Searches included PubMed, Scopus, Web of Science, and CINAHL, and unpublished reports through USAID's Clearinghouse and program listservs. The findings from the systematic review informed development of a step-by-step program guide, based on the findings, helps practitioners understand and respond to social norms to improve women's and children's diets. Programs in northern Ghana and in Niger are refining the guide based on user testing.

Results: The literature documents that social norms influence what food, how much food, and how children are fed. Norms also influence what food, how much, and when women can or cannot eat. Although women are usually tasked with food preparation and feeding, cultural norms in many contexts limit decision-making on food allocation or the ability to go against elders. The review found a growing trend among programs to include strategies to address social and cultural norms in nutrition and evidence for positive change, although the evidence is still limited. Norms-focused approaches combine community engagement and innovative media, reaching multiple family members or whole communities.

Conclusions: Nutrition practitioners can improve outcomes by responding to underlying social norms, whether positive or harmful. Local input and partnerships are key for considering social norms within broader cultural contexts and avoiding stigma or over-simplification.

Keywords: culture, social norms, SBC, child feeding, maternal diets

Conflict of Interest Disclosure: There is no conflict of interest.

Further Collaborators: There is no conflict of interest.

OAB(T5)1-4

Women's and family members' experience of participating in a practical demonstration based maternal nutrition education intervention: Qualitative evidence from rural Bangladesh.

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Background and objectives: Maternal under-nutrition is widely prevalent in South Asia, including Bangladesh. Undernutrition is associated with an inadequate food intake but choosing appropriate amounts of different foods is crucial. We developed a nutrition behaviour change communication to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

promote a balanced diet in pregnancy in rural Bangladesh and tested the impact with a cluster randomized controlled trial. The nutrition education was delivered through practical demonstrations of a balanced plate with appropriate portion sizes. As part of the evaluation, we conducted qualitative assessments to examine the barriers and coping strategies to adhere to the intervention from the perspectives of women, families and providers.

Methods: We conducted in-depth interviews (n=24) with pregnant women, recently-delivered women, and husbands; focus groups with mothers-in-law (n=7), and key-informant interviews (n=6) with community health workers who provided the nutrition education intervention.

Results: We revealed differences in experience reported by women, mothers-in-law and husbands regarding participating in the intervention. Pregnant women experienced visual presentation effective in recalling messages and easy to apply in practice. They often needed to borrow certain food items to make the balanced plate which supported a culture of food sharing. Some mothers-in-law found the messages contradictory to their traditional knowledge but accepted them considering the wellbeing of an unborn grandchild. Husbands felt the practical demonstration of portion seizes as an innovative and unconventional approach to nutrition education and were attracted to participate. Health workers regarded the intervention as an expansion of opportunity to engage with the community and use their professional training and everyday experience to educate their local community. Dominant barriers to complying with the intervention included financial constraints and scarcity of animal source foods. To cope with the additional costs for pregnant women's balanced diet, families often adjusted the budget or sourced freely available or cheaper local alternative produce.

Conclusions: Maternal nutrition intervention through practical demonstration of portion sizes has potential for high uptake and adherence. Interventions should utilize local food culture, and engage families and community health workers to mobilise social support to create an enabling environment to bring changes in dietary habits to optimise maternal nutrition.

Keywords: Maternal nutrition education, Balanced plate, Users' experience, Qualitative assessment, Food culture

OAB(T5)1-5

Insights from community health workers on persuasive counseling of family members to improve maternal nutrition and breastfeeding behaviors in rural Bangladesh

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Background and objectives: Community health workers (CHWs) increasingly provide nutrition education and counseling to childbearing women and their families to improve adoption of recommended maternal and child nutrition behaviors. Little is known about CHWs' first-hand experiences garnering family support for improving nutrition practices in low-resource settings. Using focused ethnography, we aimed to draw insights from CHWs on strategies they employed to persuade family members to support recommendations on maternal diet, rest, and breastfeeding in a behavior change communication intervention in rural Bangladesh.

Methods: We interviewed 35 CHWs providing at-home nutrition education and counseling to rural pregnant women and their families in seven 'Alive & Thrive' intervention sites across two resource-poor districts in northern Bangladesh. In-depth probing focused on how CHWs addressed beliefs around maternal diet, rest, and breastfeeding, cultural food practices during pregnancy and postpartum, and lack of family support. Thematic coding based on Fisher's narrative paradigm revealed strategic use of three rhetorical principles by CHWs: *ethos* (credibility), *pathos* (emotion) and *logos* (logic).

Results: In addition to pregnant women, all CHWs reported educating male and female adults during home visits. CHWs selectively targeted husbands and mothers-in-law for counseling given their influence on behavioral adoption as food procurers and family health and nutrition advisors, respectively. Several CHWS identified the cultural belief of restricting gestational food intake and rest to avoid cesarean delivery as an important challenge. CHWs reported that families were motivated to support maternal food intake and breastfeeding when they heard about benefits like improved fetal growth and child intelligence while improved maternal health was the least motivating outcome, even among mothers. Logically coherent messaging resonated well with husbands, while empathetic counseling was additionally required for mothers. Mothers-in-law were most intransigent but were persuaded via emotional appeals. Persuasion on maternal rest was most effort-intensive, resulting in contextually appealing but scientifically inaccurate messaging ('mother rests, baby rests').

Conclusions: Our study demonstrates that CHWs can offer important insights on context-relevant, feasible counseling strategies to improve family support and uptake of nutrition recommendations. It also identifies need for focused CHW training and monitoring to address persuasive but scientifically-flawed counseling narratives.

Keywords: Behavior change communication, Community health worker, Family counseling, Maternal nutrition, Persuasion

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T5)1-6

Usage of Local Traditional Food for Food Education at Kindergarten to Improve Students' Food Literacy

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Background and objectives: In Japan, the Basic Act on *Shokuiku* (Food and Nutrition Education) was established in 2005, and food education has been promoted nationwide for all ages. Food literacy including knowledge and skills regarding healthy eating is significant for lifelong well-being and it can begin to be taught at young age. At the same time, usage of local traditional food as learning subjects would support not only local agriculture but also sustainable food systems in our society. The objective of this research is to evaluate the effects of food education that utilizes local traditional food in order to enhance young children's food literacy.

Methods: The participants were thirty students aged 5-6 years old. We selected a famous local traditional food, green soybeans (*Edamame*), as a learning subject. Our food education program was implemented at a local kindergarten from June to October, 2021 in Yamagata prefecture, Japan. The program contained four lessons in which students learned about soybeans' nutrition and various products made from it. Students also participated in preparing and eating green soybeans together. For assessment of this program, we prepared quizzes and investigated how the students' understandings about soybeans changed after learning. We also asked the students' parents to answer a questionnaire about daily meal preparation at home.

Results: After our program, the percentage of the students who could correctly answer the quiz about the nutritional characteristics of soybeans increased from 10.0% to 60.0%. Also, their knowledge about its growing processes and soybeans-derived products improved. These results suggested that their food literacy improved through our program. From the questionnaire it was found that more than 90% of the parents used local farmers' markets to buy food for family meals.

Conclusions: Agricultural areas like Yamagata prefecture may have many resources and advantages when it comes to teaching children about healthy and sustainable eating by way of locally grown fresh food. It can be expected that food education at kindergarten could enhance young children's food literacy more effectively by integrating it with family eating habits at home.

Keywords: Food Literacy, Food Education, Local Food Culture, Kindergarten

OAB(T5)2-1

Indonesian Adolescent Girls Are Aware of the Importance of Healthy Eating and Physical Activities but Having Limited Knowledge on Balanced Diet

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Background and Objectives: Adolescent girls in Indonesia are facing various nutritional problems, such as anemia and unhealthy eating habits. This is often driven by inadequate knowledge and misconception about health and nutrition. Our study aims to explore Indonesian adolescent girls' perspectives on general health, nutrition, and balanced diet.

Methods: This study is part of a larger study to develop nutrition education apps to prevent anemia among adolescent girls from low-mid social-economic. A Qualitative approach using Focus Group Discussion (FGD) was applied to explore perceptions of 23 adolescent girls. FGD was conducted in three batches with 7-8 participants in each FGD. Each FGD was recorded upon the permission of participants and transcribed verbatim, then analyzed using thematic analysis.

Results: Adolescent girls revealed that health is an essential aspect of their lives and perceived health as an investment for their future. Health is perceived as an asset for the future to prevent non-communicable diseases in later life and to generate a better generation. Furthermore, they define maintaining healthy eating and physical activities as an effort that can be performed to achieve a healthy life. Although adolescent girls are aware of the benefit of healthy eating and physical activities on health, they have an uncomprehensive understanding of healthy eating and balanced diet. When asked about healthy foods, adolescent girls mentioned fruits and vegetables along with high-priced foods such as milk and meat as healthy foods. Empat Sehat Lima Sempurna (Four Healthy Five Perfect), previous Indonesian dietary guidelines, was mentioned as definition of healthy eating. On the other hand, no one of the adolescents identified Gizi Seimbang (Balanced Diet), the current Indonesian dietary guidelines which developed based on the nutritional needs of each age group, as healthy eating. In addition, adolescents are facing several barriers in developing a healthy lifestyle, such as skipping meals due to poor time management, picky eating habits, peer influence, food availability and affordability, and sedentary habit.

Conclusion: Our study highlights the urgency of nutrition education for adolescent girls, specifically on the promotion of balanced diet and affordable healthy foods. Moreover, it should also cover practical and barriers management aspects.

Keywords: adolescent, nutrition education, balanced diet, health, qualitative

Conflict of Interest Disclosure: This study received funding support from University of Hasanuddin through LPPM UNHAS [grant number 2215/UN4.1/KEP/2021]

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T5)2-2

Nutrient Quality of School Meals and their Contribution to RDAs of Children, Multi Sectoral Approaches for Sustainable School Feeding Programmes in Uganda

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Background and objectives: School going children face a complicated period of growth and development, which remarkably affects their health and productivity. Out of the 15 million children in Uganda, about 12 million suffer from malnutrition with 29% being stunted and 11% underweight. Government nutrition interventions have limited focus on school feeding.

Methods: This study documented the various school feeding programmes, the successes and challenges experienced in implementing the programmes. Four levels of assessment were conducted and included: I conducting 11 key informant interviews, II conducting 45 focus group discussions III carrying out indicator-based observation evaluation of facilitates and IV evaluating the nutritional quality of school meals among 225 school going children.

Results: Two forms of feeding programmes: parent led and home grown, school feeding programmes were implemented concurrently. This is possible through the financial and in-kind contributions made by parents. In some districts, school feeding is enforced through local government ordinances. All students benefitted from the existing school feeding programmes. Parents with children in secondary schools had less difficult in making contribution towards school feeding. About 90% of the learners ate food items from 2-4 food groups (cereals, pulses and legumes, vegetables and bulbs). Children in all categories of schools were supplied with sub optimal daily nutrients (energy, proteins, vitamin A and iron) from school meals. Nationally, school children were only accessing 28% of their energy needs, 64% proteins requirements and 42% of iron requirements. School meals provide about 40 to more than 100% vitamin A requirements about 40-62% of iron requirements and about 30% daily energy requirements.

Conclusions: In order to improve school feeding in the country there is need to enhance coordination and stakeholder engagement; improve the nutrient content of school meals and engage stakeholders to change their attitudes and practices toward healthy eating. The current school feeding and nutrition guidelines need to be reviewed holistically using multi-sectoral approaches. There is need to strengthen local and community focused school feeding, including establishment of local committees and implementing school feeding where appropriate.

Keywords: Farm schools, dietary diversity, education evaluation, agriculture

Conflict of Interest Disclosure: No known competing interests or personal relationship that could have appeared to influence the work reported in this paper.

OAB(T5)2-3

Agricultural based projects in conjunction with nutrition education enhance dietary diversity of women and children in Tanzania

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Background and objective: Agricultural programmes have traditionally focused on increasing the availability of food rather than promoting consumption and improving nutrition status. This study examined the effect of nutrition sensitive interventions on dietary diversity of women and children. It hypothesized that agriculture can improve diets of women and children through vegetables and chicken production for household consumption if coupled with nutrition education.

Methods: A cluster randomised study design involving 1762 households evaluated the effect of nutrition education, chicken and vegetable production on consumption. Study villages were allocated to three treatment arms namely, vegetable + chicken, chicken only and Control. The vegetable + chicken villages obtained improved chickens and a package of nutrition education to promote behaviour change and resources for household vegetable production. The chicken only villages obtained improved chickens without a package of nutrition-sensitive interventions, and the Control villages did not receive any of the treatments. Data were collected from central semi-arid, eastern sub-humid and southern highlands agro-ecological zones using mobile devices on ODK system.

Results: The mean general nutrition knowledge score at endline was 2.1 for the control, 3.0 for chicken only and 3.1 for vegetable + chicken ($p<0.0001$) treatment arms. Mean household dietary diversity score at endline was 5.6 compared to 5.2 at baseline. Household dietary diversity score (HDDS) was significantly higher in chicken only ($\beta=0.3274$, $p=0.0278$) and vegetable + chicken ($\beta=0.3434$, $p=0.0193$) treatment arms compared to the Control treatment arm. The increased HDDS was significantly associated with zones ($p=0.0239$) and ownership of improved chickens ($p=0.0002$). Women's dietary diversity score at endline was higher in chicken only and vegetable + chicken treatment arms compared to the Control treatment arm. Consumption of more than four food groups among children increased from 48% at baseline to 75% at endline contributed by cereals, oils and fats, fruits, vegetables, chicken meat and eggs.

Conclusion: Both crop and livestock projects improved consumption of diversified diets for women and children more with nutrition education intervention than on their own. Clearly, development of agricultural interventions needs to incorporate nutrition considerations in the planning and implementation of activities to ensure improved agricultural productivity and nutrition.

Keywords: nutrition knowledge, nutrition education, agriculture/livestock, nutrition sensitive package, women dietary diversity score

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: None
Further Collaborators: None

OAB(T5)2-4

Fruit and vegetable consumption practices among Pacific and New Zealand European women with different body composition profiles

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Background and objectives: Obesity is a major health concern in New Zealand (NZ) and is closely related with diet. Current fruit and vegetable consumption practices of NZ women are unclear. This study investigated fruit and vegetable intake and consumption patterns of Pacific and NZ European (NZE) women with different body composition profiles.

Methods: Women (142 Pacific; 161 NZE) living in Auckland were recruited. Fruit and vegetable intake were isolated from 5-day Food Records and 7-day Dietary Diversity Questionnaires. Anthropometric measures and Dual X-Ray Absorptiometry were used to assess body composition. Spearman's rho correlation coefficients and multiple linear regressions were used to analyse the relationship of fruit and vegetable serves and body composition, and to analyse predictors of body composition.

Results: Combined daily median fruit and vegetable serves differed significantly between normal BMI women (Pacific: 3.24 (2.33, 4.26) and NZE: 4.70 (3.71, 6.35). Among obese BMI women, NZE ate significantly more servings of vegetables (2.81 (1.77, 3.93) than Pacific (1.92 (1.35, 3.27). Combined daily- and vegetable servings, adjusted for age and ethnicity, were inversely correlated with BMI (-0.15, -0.16) and BF% (-0.21, -0.20) respectively, particularly for green (-0.14, -0.18) and yellow Vitamin-A-rich (-0.12, -0.14) and cruciferous (-0.13, -0.18) vegetables. Every one serve (75g) of vegetables predicted a 0.65kg/m^2 reduction in BMI and 1.16% reduction in BF% for women combined (P<0.01). Most women did not consume recommended fruit and vegetables servings, independently of ethnicity, BMI or BF%. NZE consumed significantly more yellow vitamin-A-rich and cruciferous vegetables; Pacific consumed more starchy vegetables. Pacific women consumed the highest servings later in the day (Lunch, Afternoon tea, Dinner) than NZE (Breakfast, Lunch, Dinner) (P<0.01). Most consumed vegetables and fruit were carrots, onions, lettuce, tomatoes and potatoes, and bananas and apples. No differences in energy or nutrient intakes were observed between BMI and BF% groups within ethnicities. However, comparatively, women with normal BF% had increased total carbohydrate and total sugar intakes from fruit and vegetables.

Keywords: Fruit and vegetable recommendations, Diversity, Serves, Meal timing, Nutrient intakes

Conclusion: Daily serves of fruit and vegetables were significantly correlated with body composition despite low overall intake. Pacific and NZE women had significantly different fruit and vegetable intakes and consumption patterns.

OAB(T5)2-5

Achieving a Planetary Health Diet: 'Veggie Monday' School Lunch and the Potential of School Lunch in Japan

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Background and objectives: The aim of school lunch in Japan is not limited to the maintenance and improvement of health. It also includes many elements such as the formation of desirable eating habits, an understanding of traditional food culture, the development of attitudes that contribute to environmental preservation, and a correct understanding of food production, consumption, and distribution. In addition, after the EAT-Lancet Commission Report "Food in the Anthropocene", a Great Food Transformation is required to simultaneously achieve human and planetary health through food systems. We report practical activities through the regular provision of vegetarian meals in school lunch programs in Japan. Vegetarian school lunches are not simply a denial of meat-eating, but also a menu that incorporates many elements, such as helping students overcome their dislike of vegetables and maintaining their health, reviewing the good qualities of Japanese food, gaining knowledge of global food issues, and deepening their understanding of food distribution.

Methods: In line with the global Meat Free Monday movement, vegetarian lunches have been offered at school lunches in public junior high schools in Fukushima Prefecture every Monday since 2019. By implementing nutrition education in conjunction with the provision of vegetarian school lunches, the program aims to deepen students' understanding of sustainable diets and encourage behavioral change.

Results: By implementing vegetarian school lunches on a regular basis, students and parents were able to understand the purpose of implementing the menu. Over 79.9% of the total number of students responded: "very concerned/concerned about food and the environment" on the eating habits questionnaire. Behavioral changes were observed, such as students themselves conducting leftover food surveys and showing appreciation for food. However, the percentage of students with obesity levels of 20% or higher remained unchanged at 16.4%, and it is necessary to promote nutrition education that also involves families.

Conclusions: Regular vegetarian lunches can be provided in school lunch programs, and when combined with nutrition education, students can become more concerned not only about their own health issues but also about global environmental issues.

Keywords: food systems, vegetarian diet, school meals, nutrition education, planetary health

Conflict of Interest Disclosure: NA
Further Collaborators: NA

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T5)2-6

Assessment of consumer's knowledge, perception and behavior regarding food labels

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Background and objective: Food label is an effective communication tool. It attracts consumers to select nutritionally appropriate food, and food makers can promote and share elementary information. The aim of this cross-sectional study was to assess consumers' knowledge, perception, and behavior regarding food labels in Mirpur A.K, Pakistan.

Methods: Data was collected from 384 consumers between the ages of 20 and 60 years, comprising both genders. A random sampling technique and a structured questionnaire were used for data collection. The reliability and validity of the questionnaire were assessed using Keiser Meyer Olkin (KMO), the Bartlett's test of Sphericity and Cronbach's Alpha coefficient. Descriptive statistics, Pearson's correlation, and linear multiple regression was used for data analysis.

Results: The results showed that more than half of consumers knew about food labels, half of consumers perceived that reading the food labels is always important, while 24% of consumers always, 18.5% often, and 42.2% sometimes read food labels. *Knowledge*: a sizable portion of consumers had knowledge of brand name and dates, and mostly consumers knew about sugar-free products, ingredients list, calories, fat, vitamins and minerals. *Perception*: more than half of the consumers' perceived that taste and price are always important when buying food. *Behavior*: most consumers always check the expiry date. The Pearson's correlation coefficient is significant at 0.01 and a moderate negative correlation exists between consumer knowledge with perception and behavior, while a moderate positive relationship exists between perceptions with behavior. Multiple regression analysis contributed significantly at $p<0.05$ and eight predicated variables explained 46.1% variation with dependent variables consumers' knowledge, 20.0% variation with consumers' perception and 32.1% variation in consumers' behavior regarding food labels.

Conclusion: The study concluded that mostly consumers have knowledge about brand name, dates, sugar-free products, ingredients list, fat, vitamins, and minerals. Most consumers perceived that price and taste are important and mostly consumers read price and recipe information, difficulty in sub type of fat, serving size, sodium, and CHO. The suggestions for manufacturers to use simple language for consumers and for health professionals and the government to conduct awareness programs regarding food labels.

Keywords: Consumer, Food Label, Knowledge, Perception, Behavior

Conflict of Interest Disclosure: There is no conflict of interest between authors.

OAB(T5)3-1

Teaching activities continued at pre-schools during the COVID-19 pandemic: The case in Subang, West Java, Indonesia

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Background and objectives: The objectives of the study were to assess learning implementation by teachers of pre-school students during the COVID-19 pandemic, including whether nutrition related topics were taught, and anthropometric measurements were assessed. The study was conducted in Subang district, West Java province, Indonesia.

Methods: Google online survey platform was used to collect the data in September 2021. Questions related to September 2020 was asked retrospectively.

Results: 139 teachers responded to the questionnaire. In September 2020, 42% of the learning process was organized online, 18% offline (students came to school), and 40% combination of the two methods. In September 2021, 98% were offline. We categorized the learning implementation into four online and three offline channels, namely using Whatsapp, zoom, Google meet, video call, Facebook messenger, attendance by the students, home visit by the teacher, and school visit by the parents. Information from teachers to students were delivered via social media, home visit, or at school. Majority of the teachers used Whatsapp for delivering materials and communication with parents by forming Whatsapp group. Parents played a role in facilitating their children using the social media for online learning. The home visit can be private tutoring for one student or for several students who gathered in one house. The offline method at school was implemented following the government's health protocol. Assignments in the form of videos or pictures were commonly submitted via Whatsapp. Combination of channels were used by the teachers. Dissemination of nutrition topics such as food and washing hands were taught throughout these two time periods. Monitoring of weight and height of the students were commonly done through the village health post (*Posyandu*). Teachers who conducted anthropometric measurements decreased from September 2020 to September 2021 (97% to 83% respectively for weight and 96% to 83% respectively for height).

Conclusions: Teachers implemented various channels to disseminate information to students and parents, adapting to the pandemic. Dissemination of nutrition information continued despite of the limitations.

Keywords: pre-school, teaching, COVID-19, online, Indonesia

Conflict of Interest Disclosure: The authors have no conflict of interest.

Further Collaborators: None

OAB(T5)3-2

Dietary diversity modification through school-based nutrition education among Bangladeshi adolescent girls: a cluster randomized controlled trial

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Background and objective: Adolescents gain up to 50% of their final adult weight, 20% or more than that of their adult height and 50% of their adult skeletal mass; of this entire growth, most is achieved during the early adolescence. Adolescence is the last opportunity to intervene and break the vicious cycle of inter-generational malnutrition. Previous studies revealed that nutrient inadequacy and inadequate dietary diversity are the major causes of adolescent malnutrition. We aimed to measure the efficacy of school-based nutrition education on dietary diversity of the adolescent girls in Bangladesh.

Methods: A matched, pair-cluster randomized controlled trial was conducted from July 2019 to September 2020. Randomization was done to select intervention and control schools. There were 300 participants (150 in intervention and 150 in control arm) at baseline. We randomly selected our study participants from grade six, seven and eight of each school. Our intervention components included parents' meeting, eight nutrition education sessions, and distribution of information, education and communication materials. An hour-long nutrition education session was provided using audio-visual techniques in a class of intervention school once in a week by trained staff for two months. We calculated mean dietary diversity score of adolescent girls at baseline and at endline.

Results: Mean age of the adolescent girls were 12.31 years and 12.49 years in control and intervention arms respectively. Percentages of consumption of organ meat, vitamin A rich fruits and vegetables, legumes, nuts and seeds were higher in intervention arm than in control arm at end-line. Mean dietary diversity score remained unchanged in control arm 5.55 (95% CI: 5.34 - 5.76) at baseline and 5.32 (95% CI: 5.11 - 5.54) at endline. After intervention, mean dietary diversity increased from 4.89 (95% CI: 4.67-5.10) at baseline to this mean was 5.66 (95% CI: 5.43-5.88) at endline. Result from difference-in-difference analysis revealed that the mean dietary diversity was likely to increase by 1 unit due to intervention.

Conclusion: The study has clearly demonstrated the feasibility of the school-based nutrition education intervention for improving dietary diversity of adolescent girls and so, the intervention should be re-tested on a larger scale.

Keywords: Adolescent nutrition, Diet, Nutrition education, Cluster randomized controlled trial, Behavior

Conflict of Interest Disclosure: The authors have declared that no conflict of interest exists.

OAB(T5)3-3

Should food literacy be a matter of concern among women in a university community in Nigeria?

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Background and objectives: Food literacy is a set of skills and attributes that help people with the daily preparation of healthy, tasty, and affordable meals for themselves and their families. Food literacy could impact healthy food provision within the households. The study investigated the level of food literacy using five domains; nutrition knowledge, meal preparation skills, ability to plan daily meals, ability to practice healthy eating and ability to select healthy foods.

Methods: The cross-sectional study was conducted among 203 non-academic female staff of Obafemi Awolowo University, Ile – Ife, Nigeria. Data were collected using a stratified random sampling technique with a well-structured questionnaire. Descriptive and inferential analyses were done using percentages, mean and standard deviation and Pearson's correlation and Chi-square.

Results: The mean age was 45.38 ± 10.98, and 83.7% were married, with a mean household size of 5.12 ± 1.65. About half of the women (55.7%) were rated high in the ability to plan daily meals. Only 41.9%, 18.7%, 36.0% and 39.9% were rated high in nutrition knowledge, food preparation skills, ability to practice healthy eating, and ability to select healthy foods, respectively. The cumulative food literacy score showed that 19.2% of the respondents were rated high and low. Food preparation skills ($r = 0.294$, $p<0.01$), daily meal planning ($r = 0.202$, $p<0.01$), and ability to select healthy food ($r = 0.206$, $p<0.01$) had a positive and significant relationship with nutrition knowledge. The household type also had a positive and significant relationship ($\chi^2= 55.511$, $p<0.001$) with food literacy. Households with more members were thrice more likely to have low food literacy (OR =3.34, 95% CI (0.62-2.75).

Conclusion: Food literacy was low among the women in the study area. Food literacy promotes personal health and well-being and is associated with a healthier diet. A food literacy programme should be established in the university community to provide nutrition education for healthy living.

Keywords: Food literacy, Nutrition education, Nutritional knowledge, Healthy eating, Meal planning

Conflict of Interest Disclosure: No Conflict of Interest

OAB(T5)3-4

Food choice motivators and food literacy in relation to diet quality in Japanese adults aged 19–80 years: a nationwide cross-sectional study

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Background and objectives: Little is known about how motivators of food choice, as well as food literacy, are related to food consumption in free-living settings. We cross-sectionally examined the associations of food choice motivators and food literacy with diet quality in a nationwide sample of 2231 Japanese adults aged 19–80 years.

Methods: We assessed eight food choice motivators (accessibility, convenience, health/weight control, tradition, sensory appeal, organic, comfort, and safety, using a 25-item scale) and food literacy characterized by nutrition knowledge (using a validated 143-item questionnaire), cooking and food skills (using 14-item and 19-item scales, respectively), and eight eating behaviors (hunger, food responsiveness, emotional overeating, enjoyment of food, satiety responsiveness, emotional undereating, food fussiness, and slowness in eating, using the 35-item Adult Eating Behavior Questionnaire). Dietary information was collected using a validated brief-type diet history questionnaire, and diet quality was assessed using the Healthy Eating Index-2015 (HEI-2015). All the variables were included into a sex-specific multiple linear regression model simultaneously, as well as age, body mass index (based on self-reported weight and height), and the ratio of energy intake to estimated energy requirement. The variance inflation factor scores for any variable in any model (range: 1.11–3.91) were within acceptable limits (<10), suggesting that multicollinearity was not an issue. Regression coefficients (β) were calculated as the change of the HEI-2015 with 1-SD increase of each variable.

Results: The mean (± SD) HEI-2015 was 55.5 ± 6.5 for males (*n* 1068) and 57.2 ± 6.6 for females (*n* 1163). HEI-2015 was positively associated (P <0.01) with food choice motivators of health/weight control (β: 0.82) and organic (β: 0.82), nutrition knowledge (β: 0.49), and slowness in eating (β: 0.52) and inversely with food fussiness (β: −1.17). In females, HEI-2015 quality was positively associated (P <0.05) with food choice motivators of health/weight control (β: 0.79) and safety (β: 0.54), nutrition knowledge (β: 0.44), and cooking skills (β: 0.67) and inversely with a food choice motivator of accessibility (β: −0.43), emotional overeating (β: −0.42), and food fussiness (β: −0.47).

Conclusions: These findings would provide a basis for developing more targeted and effective strategies for healthy eating.

Keywords: motivators, literacy, food, diet, Japan

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T5)3-5

Assessment and modification of food and physical activity environment (FPAE) of Workplaces as a part of a Workplace Wellness Programme (WWP)

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Background and objectives: The workstyle of Information Technology (IT) employees in India is dominantly sedentary and exposes them to obesogenic environment, contributing to the growing rate of Non-Communicable Diseases (NCDs). The workplace environment influences physical, mental and social well-being of employees and potentially impacts their health-related behaviour. Turning workplaces into effective locations through Workplace Wellness Programs (WWPs) can contribute in prevention of NCD risk factors. The objective of this study was to assess the food and physical activity environment (FPAE) of the workplaces and to modify it by implementation of a flexible and strategic WWP model.

Methods: The FPAE of the workplaces was evaluated using a 36-item checklist developed by modifying and contextualising the guidelines issued by WHO and Food Safety and Standard Authority of India (FSSAI). Ground Truthing - a systematic on-field surveying method - was used to assess the availability, promotion of healthy food items, presence and utilisation of physical activity facilities, strategies for creating stress-free environment. The FPAE of three IT companies of varied sizes [Big-(A), medium-(B), small-(C)] located in Hyderabad, the IT hub of India were assessed. A multi-component WWP model with interventions at individual, interpersonal and organisation levels was developed and implemented. At organisational level, modification of FPAE was attempted to create an enabling environment for promoting healthy lifestyles.

Results: On the 36-point checklist, company A, B, C scored 21, 12 and 7 respectively. Ground truthing revealed healthy foods were neither available nor primed in the cafeterias of the companies. Physical activity facilities were not uniform in all companies. Even in places where they were available, they were under-utilized. Voluntary participation in the intervention program was 13.4%. FPAE modifications introduced were - replacing beverage vending machines with healthier options, priming healthy foods in cafeterias, promoting stair usage instead of elevators, post-lunch walk breaks. Positive motivation and active involvement of employees and management was observed resulting in minor changes in BMI and triglyceride levels of the employees.

Conclusion: The WWP modifying the FPAE along with health education at employee level resulted in healthy behaviour changes at the workplaces.

Keywords: Food environment, employee health, Workplace wellness programme

OAB(T5)3-6

Empowering communities to transition to healthier, more diverse diets – insights from Turkana County

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Background and objectives: Participatory approaches, described as a group of approaches or methods that enables rural people to analyze their resources/assets, share and enhance their knowledge enabling them to plan and act on their own development/future are gaining importance in many disciplines including nutrition sensitive agricultural programming. The integrated community-based approach for farm, market and diet diversify was first conceptualized and tested in the Humid tropics of Western Kenya. The present project aims to pilot – test the approach in a contextually different Turkana County in Kenya, an area inhabited by transhumance pastoralists and characterized by high temperatures, unreliable and erratic rainfall and frequent droughts.

Methods: The study was conducted within the framework of a cluster – randomized control study design. From the 17 communities sampled for the baseline survey, 10 community groups (382 households) were randomized to receive treatment delivered in two phases: a) participatory intervention co-creation phase implemented through six community workshops in each of the communities resulting in the development of community action plans (CAP) for farm and diet diversity, and b) participatory intervention implementation and monitoring phase where the communities implemented interventions and received nutrition counseling as outlined in the action plans with targeted technical support.

Results: At baseline, only 5% of the households surveyed had kitchen gardens. During the CAP co-creation phase all 10 community groups decided to go for kitchen gardening. Additionally, 4 and 2 communities respectively implemented village savings and loaning (VSL), and poultry rearing. Monitoring reveals 100% adoption rates of kitchen gardening among the group members, but low adoption of poultry rearing (22%). The number of indirect beneficiaries with kitchen gardens also increased. A total of KES. 600,880 ($ 5,500) was saved in the VSL activities and 194 households benefited from loans extended to them as start up for small businesses and paying children's school fees.

Conclusion: Evidence from project monitoring shows that it is quite likely the project had a positive impact on the diets, incomes and livelihoods of the communities which demonstrates that the approach can equally work in difficult contexts such as Turkana. An endline evaluation is planned to take place in the coming weeks.

Keywords: participatory approaches, Turkana, diet diversity, farm diversity

Further Collaborators:
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OAB(T5)3-7

The role of gender on the food environment in Ghana in relation to households food acquisition and consumption

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Background and Objectives: Gender dynamics play a significant role in household food security and consumption. The main objective of this study was to determine food acquisition and consumption differences between households where a man or woman is in charge of food acquisition. The study also sought to determine the gender roles within food value chains of six major food commodities to determine where gender-specific policies can target.

Methods: A household food frequency questionnaire was used to assess the food consumption patterns in households and obtain information on household food sourcing. On the food value chain, six commonly consumed foods, three health-promoting foods, and three non-health promoting foods were used in the study to know their wholesale and retail patterns by the gender groups. The snowball and purposive sampling techniques were used to identify food retailers and wholesalers of the six identified food commodities. Two communities were selected; one rural and one urban community. Household members above 18 years who were knowledgeable about household food consumption were selected for the study.

Results: Poverty was higher in female-headed households compared to male-headed households. The findings reflected that 63% of the total female respondents reported low risk but vulnerable which is similar to that of the male where the majority, 62.7% of the total male respondent were low risk but vulnerable as well. For Lived Poverty Index (LPI), female respondents had the highest deprivation level due to poverty 40.32% while the male was 27.41. Generally, women recorded the highest 99% seldom consumption of obesogenic promoting foods compared to men with 95.6% in seldom consumption of unhealthy food. The findings on the food chain value depicted that on a scale of 50 to 70%, 55.8% of the respondent said more men are into the production of food commodities compared to women whereas 29.9% of respondents said 50 to 70% of producers are women.

Conclusion: It is necessary that we do not overlook the important role gender plays in the food chain value, household food acquisition, and consumption based on the findings from the study.

Keywords: food acquisition, nutrient-consumption, gender-dynamics, food chain value

Conflict of Interest Disclosure: No conflict of interest

OAB(T5)4-1

Empowerment Model in Randomized Control Trial to Increase Vegetable Intake and Achieve Glycemic Control in Indonesian Adults with Type 2 Diabetes Mellitus

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Background and objectives: Life style changes, particularly in dietary patterns have contributed a great deal to the incidence and risks of type 2 diabetes mellitus. There are barriers in consuming vegetables, i.e. non-existing habit, taste and servings, besides cognitive aspects on carbohydrate choices and food preparation techniques. Mediating variables that impede or facilitate self-dietary care of diabetes may include the level of social support, the degree of self-efficacy and the individual's time management skills. Facilitating behavioural change from non-adherence to adherence is essential. A coaching approach can be used to encourage positive choices, develop self-sufficiency and assist people in identifying and overcoming barriers. The study aims to investigate the effectiveness of The Empowerment Model to enhance vegetable intake in adults with type 2 diabetes mellitus to achieve glycemic control.

Methods: This is a 12-week mixed methods research, applying both quantitative and qualitative data in a single study. Qualitative study was embedded within quantitative methodology which was a two-arm non blinding randomised controlled trial. Individuals with known type 2 diabetes and poor glycemic control (HbA1c ≧8 g%) were eligible and a total of 84 subjects were recruited. Assigned by clustered randomisation, subjects in the intervention group (n=41) received weekly coaching using The Empowerment Model module and the control group (n=40) followed the conventional diet according to the guidelines of Indonesian Society of Endocrinology.

Results: There was significant difference in change of vegetable intake of the intervention group compared to the control group ($p<0.001$). HbA1c decreased significantly in the intervention group compared to the control group ($p=0.009$). Fasting blood glucose, post prandial blood glucose in the intervention group decreased significantly along with bodyweight, waist circumference, and total cholesterol. Qualitative study demonstrated that health provider's positive attitudes defined subjects' attitudes in creating adherence during coaching sessions with the presence of encouragement and acknowledgment, learned lessons, process honoring, buddy's involvement, confidence and self-regulation, also outreaching ability being role model to enrol others in consuming more vegetables.

Conclusions: The Empowerment Model improved vegetable intake and the intervention significantly reduced HbA1c.

Keywords: The Empowerment Model, Type 2 DIabetes Mellitus, Vegetable, Glycemic control, Indonesia

Conflict of Interest Disclosure: We have no conflict of interest with any financial or non-financial aspects in the subject matter or materials used in the study

OAB(T5)4-2

The nutritional intervention of counseling and cooking assistance on hypertensive patients

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Background and objective: Nutritional recommendations for people with hypertension set by WHO include limiting sodium/salt intake to achieve or maintain normal blood pressure; consume adequate amounts of carbohydrates from nutrient-dense foods such as vegetables, fruits, whole grains, and legumes; and consume enough fiber. The purpose of this study was to determine the effectiveness of the intervention to reduce salt intake in hypertensive patients.

Method: The design of this study was a quasi-experimental study using a control-treatment group comparison. The research location is in the Kendalkerep Health Center area of Malang city, carried out in July - October 2019. The total participants were 100 people with hypertension (50 people in the treatment group, 50 people in the control group). Participants come from various ethnic groups and socio-demographic backgrounds. The intervention was carried out by providing nutritional counseling, physical activity, and cooking assistance to patients and families with hypertension. The results measured were blood pressure and four days (4-d) food records (3 normal days and 1 holiday/weekend) for 24 hours. Processing of statistical analysis using the Independent T-test, Wilcoxon Mann Whithney, and Logistics Regression.

Results: The average respondent was 66 years old, female, married status, Javanese ethnicity, elementary school education level, does not have a job, and income is below the minimum wage. From the results of BMI and abdominal circumference measurements, most of the respondents were overweight. The results of blood pressure showed a decrease after the intervention was given.

Conclusion: There is a significant difference in blood pressure before and after treatment. However, there was no difference in anthropometric status and salt intake. There is a significant difference in blood pressure before and after treatment. However, there was no difference in anthropometric status and salt intake.

Keywords: nutritional intervention, counselling, high blood pressure

Conflict of Interest Disclosure: The authors declare that there is no conflict of interest.

OAB(T5)4-3

Food culture as a key component to understanding sustainable diets and building food systems resilience for times of concomitant crises: an example from three distinct regions in Chile

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Background and objectives: Together with ongoing climate change, Chile has experienced a 2019 social crisis that destroyed supermarkets; and the COVID-19 pandemic that has negatively affected livelihoods. Sustainable diets are: culturally acceptable; protective of the natural environment; physically and economically accessible; and nutritionally adequate. To assess sustainable diets as a potential solution for food systems resilience in times of concomitant crises, an understanding of present-day food culture is imperative. The study objectives were to describe traditional – culturally relevant – Chilean culinary preparations in three distinct geographic areas; to understand the sustainability of said preparations and; to develop nutrition education interventions to promote healthy and sustainable diets in Chile.

Methods: The study was conducted in the north (Arica-Parinacota), center (Metropolitan) and south (La Araucania) of Chile; with participants from 5 age- and ethnic- groups (25-45 y, 46-65 y, >65y, first nations or not). Key informant interviews (n = 15) included free-listing traditional culinary preparations and direct observations of cooking traditional recipes. Focus groups (n = 27) examined dietary frequency, taste preferences, and ingredient access of traditional culinary preparations. Semi-structured interviews (n = 80) assessed how participants perceived sustainability of 25 preparations still consumed and liked to inform educational recipe books for nutrition interventions (n = 11) that included short surveys (n = 232); and one electronic informative recipe book.

Results: Across regions, key informants free-listed 262 traditional culinary preparations. The focus groups confirmed that the traditional culinary preparations most consumed and liked vary regionally. Chileans interviewed in distinct regions perceive sustainable diets differently, especially about environmental impact, and economic access; that resulted in 9 sustainable recipes per region for nutrition interventions. Across interventions, >84% liked all recipes and >90% were willing to learn how to cook them. The COVID-19 pandemic elucidated the utility of an electronic nutrition education recipe book on sustainable diets to adapt to crisis.

Conclusions: Geographic context is inextricably linked to food culture that affects how adults perceive sustainable diets. Traditional culinary preparations are a means to operationalize food culture into practice through the promotion of sustainable diets for both human and planetary health, especially in times of crisis.

Keywords: Food culture, Traditional diets, Sustainable Diets, Food systems resilience, Chile

OAB(T5)4-4

Changes in mealtime behaviours following Taste Education intervention: Focusing on children with and without neurodevelopmental disorders and their families. A randomized controlled trial

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Background and objectives: Mealtime behaviour problems frequently occur among families of children who display fussy eating behaviours, resulting in a low-variety diet and adverse health-related outcomes, including poorer nutrition profiles, and parental worries or stress. This is especially true for children with neurodevelopmental disorders (ND), such as Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD). Creating easy-to-use tools for parents to deal with their children's difficult mealtime behaviours, is of high importance as negative experiences and parents' unwitting communication and own behaviours, may exacerbate problematic eating behaviours in their children. The aim was to investigate a parenting-education component in Taste Education food-based intervention, and whether these methods would be effective in reducing problematic mealtime behaviours in children with and without ND. This intervention has in former publications shown effective in decreasing fussy eating and increasing food variety among children.

Methods: To investigate the effect of Taste Education on changes in problematic mealtime behaviours, 81 children with ND (*n* = 33), and without (*n* = 48), aged 8–12 years, and their parents, participated in a 7-week food intervention. Children were matched on age, ND, and sex, and randomized into Immediate-intervention and Delayed-intervention groups. The study comprised two parts, i.e., a) two parenting-education sessions, 2 hours each, and b) six kitchen sessions, 90 min each. Collaborative parent/child sessions included sensory-based games, in-class hands-on training, food-based exercises at home, food preparation and easy cooking. Parents completed the Meals in Our Household questionnaire (MiOH). After adjusting for baseline measures, repeated-measures analysis-of-variance with time-points, and condition as factors (Immediate intervention and Delayed intervention), were used to examine changes in MiOH-scores with robust linear mixed-model fitted.

Results: Superior results were identified for Intervention compared to waiting on the four subscales analysed i.e., 1) structure of family meals, 2) problematic child mealtime behaviours (frequency and magnitude), 3) use of food as reward,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

4) parental concern about child diet, with stable effects through six-months follow-up. There were non-significant differences between children with and without ND.

Conclusion: The Taste Education program shows promise as a simple, non-invasive way to improve problematic mealtime behaviours in children in the long-term.

Keywords: Taste education, Parenting education, Mealtime behaviour, Fussy eating, Neurodevelopmental disorders

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OAB(T5)4-5

Education, work and food culture practices at the "Ponta Norte Agroecological Fair" in the city of Brasília (Brazil)

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Background and objectives: The "Ponta Norte Agroecological Fair" is one of the most importante street fair in Brasília (capital city of Brazil) - a weekly space for rural agricultural producers and segments of organized civil society that meets each other to exchange and sell healthy foods without the use of pesticides. The objectives of this research work focus on the analysis of the transformation and diversification of dietary habits of the inhabitants of the city of Brasília, as well as the new conceptions of nutrition disseminated by rural workers. During the covid-19 pandemic, the street fair was responsible for the direct supply of healthy food in the Asa Norte neighborhood (city of Brasília).

Methods: The methodology used for the research was focused on monitoring the weekly debates that take place at the "Ponta Norte Agroecological Fair" on topics related to nutrition sciences. Through "registration diaries", testimonies from the street fair participants were gathered about their work (rural agricultural producers) and consumption (residents who buy food at the fair) dynamics. During the covid-19 pandemic, virtual communication was used through social networks.

Results: The results obtained were compiled through the publication of campaigns for healthy eating, audiovisual records of the street fair and technical reports - in addition to the evaluation of the space for integration between education, work and renewed forms of food culture in Brazil. The publicity of the positive impacts of the street fair is carried out through social networks (@pontanorte) and by the actions of local community associations.

Conclusions: The preliminary conclusions of this work - started in December 2019 - reveal the enormous contribution of the "Ponta Norte Agroecological Fair" in guaranteeing the food security of the Brazilian population. During more than two years of existence of this space for exchanging knowledge on healthy nutrition, we can say that the "Ponta Norte Agroecological Fair" contributes not only to the food reeducation of the community, but also proposes a critical reflection on the inseparability between the valorization of workers rural areas and an emancipatory conception of nutrition Science – beside good health and happiness for future generations.

Keywords: Education, Work, Food culture practices , Brazil

OAB(T5)4-6

An evaluation of nutrition, culinary, and production interventions on the consumption of African Indigenous Vegetables in Western Kenya.

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Background and objectives: Food security continues to worsen in sub-Saharan Africa. African Indigenous Vegetables (AIVs) are yet to be fully exploited to achieve food and nutritional security. The objective of this study was to evaluate the programmatic impact of AIV interventions on food security and diet quality.

Methods: Smallholder farmers (18 to 65 years) from five counties in Western Kenya were randomly assigned to one of four treatments: 1. control (Trans Nzoia County, n=61); 2. production intervention (PI), which addressed key bottlenecks such as cultural practices, improved technologies and seeds, integrated pest management, and irrigation and drought tolerance (Nandi and Kisumu County, n=64); 3. nutrition and culinary intervention (NCI), which addressed daily intake guidelines, recipe and meal preparation, nutrition for each AIV and bodily processes supported (Bungoma County, n=55); and 4. NCI and PI (Busia County, n=70). Quantitative baseline and endline surveys were administered in October 2016 and June to July 2019, respectively. The impact evaluation was analyzed by Household Hunger Scale (HHS), Women's Dietary Diversity Score (WDDS), AIV consumption frequency, and AIV market availability.

Results: Seasonal differences resulted in an overall decrease in WDDS, HHS, and consumption frequency between baseline and endline. Despite this, postintervention, households that received NCI and PI as well as households that received only NCI demonstrated a protective effect as measured by a higher WDDS and HHS relative to the control: WDDS 5.1 ± 1.8 and 4.9 ± 1.7 vs 4.2 ± 1.5, p=0.01; HHS 0.9 ± 1.5 and 0.8 ± 1.4 vs 0.3 ± 1.0, p=0.029. In addition, between baseline and endline, there was an overall increase in the percentage of respondents that reported an adequate supply of key AIVs, particularly for households that received PI. Furthermore, seasonal effects caused a reported shift in the primary location for purchasing AIVs from the village to the town market.

Conclusions: Nutrition and culinary intervention, particularly when coupled with production intervention, provided a protective effect against the seasonal decline of availability and subsequent consumption of AIVs. Applications of such

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

interventions have the potential to improve food security in rural Kenya.

Keywords: behavior change, healthy diets, indigenous vegetables, malnutrition, orphaned crops

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

Further Collaborators: Authors report no further collaborators.

OAB(T5)4-7

Consumption of discretionary salt and bouillon cubes and related knowledge, attitudes & practices in Senegalese households

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Background and Objectives: Excessive salt consumption contributes significantly to the development of non-communicable diseases (NCDs). Sodium intake is directly linked to high blood pressure (HBP), the most important risk factor of cardiovascular diseases and mortality worldwide. The WHO has set a target of reducing population salt consumption by 30% by 2020 to contain the prevalence of HBP. To reach this target, we should address the lack of scientific evidence in low-income countries such as Senegal. Monitoring of salt consumption and obtaining information on population habits are important steps in implementing policy and key strategies to reduce salt intake. This study aimed to assess discretionary salt intake and related consumption patterns of Senegalese populations in urban and rural area.

Methods: A cross-sectional study was conducted among 57 urban (Dakar) and 54 rural (Kaffrine) households. The quantities of discretionary salt and bouillons used in the meal's preparation, were accurately measured by direct weighing method. Contribution of bouillons to salt intake was determined using national manufacturing standard. Knowledge, attitudes and practices related to salt and bouillons consumption were collected using the WHO STEPS questionnaire.

Results: Overall, individual salt intake was estimated at 6.3 g/d and was significantly higher (P<0.01) in rural than in urban areas (10.2 vs. 4.6 g/day). The individual contribution of bouillons in salt intake was estimated at 2,9 g/day and 2 g/day respectively in rural and urban areas. Based on WHO recommendation, it appears that more than two thirds of households (66,7%) had high salt consumption (>5g/d/person), particularly in rural area (94%). Despite this, 82.9% of households thought they consumed the right amount of salt. Seventy percent (70%) of urban households considered that they were able to cook without bouillon, whereas only 30.2% accorded less importance to reducing their sodium intake.

Conclusion: Salt consumption is above the WHO recommendation, particularly in rural areas in Senegal, with a significant contribution of bouillons, and highlight the need to implement a policy reduction of salt consumption.

Keywords: Salt intake, Discretionary, Hypertension, Bouillons cubes, KAP

OAB(T5)4-8

Biochemical components and sensory analysis of handmade stock and instant bonito-kelp stock in Japanese-style dishes

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Background and objectives: The Japanese soup stock "dashi", which is beneficial to health, is part of the Japanese food culture. We prepared and studied "handmade bonito-kelp stock", "four different types of instant packet bonito-kelp stocks" and "instant granule bonito-kelp stock". Our aim was to differentiate the tastes of Japanese stock by examining various factors.

Methods: In Experiment 1, we analyzed handmade and instant packet stock, and in Experiment 2, we analyzed handmade and instant granule stock. Using an instrument in Experiment 1and 2, we examined analyzed the biochemical components in the stocks: free amino acids and nucleic acid compounds. We also investigated which stocks humans identified and preferred.

Results: Experiment 1 - The handmade stock and packet stocks all featured multiple tastes with different biochemical components, including aspartic acid, glutamic acid, inosine monophosphate and adenosine monophosphate. The concentrations of biochemical components differed between handmade stock and all four packet stocks. The handmade stock and packet stocks could easily be distinguished by the human volunteers. The handmade stock was significantly preferred compared to the four types of packet stocks. Experiment 2 - Our analysis showed that handmade and granule stocks had significantly different compositions of biochemical components. For illustration, the concentrations of aspartic acid and histidine were both higher in the handmade than in the granule stock. Instant granule stocks had markedly higher concentrations of glutamic acid and 5'-inosinic acid as compared with handmade stocks. In addition, the total number of free amino acids and nucleic acid compounds differed between the handmade and granule stocks: handmade stock had many types of components, whereas granule stock had only a few types. Japanese dishes prepared with handmade or granule bonito-kelp stocks could be discriminated from one another. Conclusions: These findings imply that the composition of biochemical components is more

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

complex in handmade stocks and instant packet stocks than in instant granule stocks. The number, types, and concentration of biocomponents contained in the stock accounts for the difference in tastes of "dashi".

Keywords: Handmade bonito-kelp stock, Instant packet bonito-kelp stock, Instant granule bonito-kelp stock, Biochemical component analysis, Sensory analysis

Conflict of Interest Disclosure: There are no matters concerning conflict of interest (all authors).

OAB(T5)4-9

The integrated consumers' sustainable and healthy dietary behavior patterns among Japanese adults

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Background and objectives: Consumers are the driving force of food production and the direct cause of food waste. In the previous study, the authors developed the 30-item sustainable and healthy dietary behaviors (SHDBs) to comprehensively discuss multifaceted consumer food sustainability issues from food choice to disposal. This study aims to examine (1) the behavioral patterns of SHDBs and (2) independent predictors of each pattern.

Method: Five hundred and eight Japanese adults who took part in the self-administered cross-sectional questionnaire survey in December 2021 were included in the final sample of the present analysis. The principal component analysis was performed on the 30-item SHDBs. These items reported in the previous study composes of five scenes such as food choice (14 items, e.g., “I choose local products”), storing and preservation (3 items), cooking (6 items), consumption (2 items), and disposal (5 items, e.g., “I separate and recycle garbage”). Independent predictors of each component score were analyzed using multiple linear regression models, including demographics, psychological factors concerning SHDBs (pros and cons for the decisional balance of SHDBs and number of environmental issues of interest), and meal preparation habits.

Results: Participants' median age and BMI (25, 75%tile) were 41 (30, 50) and 21.0 (19.2, 24.0), respectively. Female were 51.0% (n=259). The following 5 SHDBs patterns and several independent predictors were identified ($p<0.05$, respectively): (1) “higher SHDBs” with male (β=-0.105), higher pros scores (β=0.134), and higher cooking frequency (β=0.443) and skill (β=0.244); (2) “lower cooking” with larger household size (β=0.102), higher age (β=0.112), household income (β=0.139), cooking frequency (β=0.268) and skill (β=0.256), and pros scores (β=0.243) and lower cons scores (β=-0.110); (3) “avoiding disposal” with higher pros scores (β=0.264), lower cons scores (β=-0.208), many numbers of environmental issues of interest (β=0.086), and higher cooking frequency (β=0.220) and skill (β=0.146); (4) “avoiding plastic products”, with higher age (β=0.130) and pros scores (β=0.138) and many numbers of environmental issues of interest (β=0.097); (5) “regarding expiry date highly” with lower age (β=-0.114), smaller household sizes (β=-0.130), and being in charge of food purchase (β=-0.136).

Conclusion: Our findings provide behavioral insight to develop strategies to promote consumers' SHDBs.

Keywords: Sustainability, Dietary behaviors, Behavioral pattern, Consumer, Decisional balance

Conflict of Interest Disclosure: The presenters declare that there is no conflict of interest.

OAB(T6)1-1

Dietary and environmental mediators of socioeconomic inequalities in child undernutrition in West Africa

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Background and objectives: A number of studies have investigated the association of socioeconomic status (SES) with child undernutrition in several regions including West Africa. However, to date no study has attempted to elaborate the possible pathways through which socioeconomic disadvantage leads to higher prevalence of child undernutrition. Document the level and trend of low birth weight (LBW), and child undernutrition in West Africa, and further establish the mediating role of dietary factors and household environmental quality in the association of SES with child undernutrition.

Methods: We analyze DHS and World Bank data for the period 1985 – 2019. Random effects model with Knapp–Hartung adjustment to the standard error (SE) was used to derive overall prevalence estimates. Fixed-effect OLS regression with cluster robust SE was used to conduct time trends analyses. 132,448 under-five children born within five years preceding the survey were investigated. Poisson regression with robust SE was used to estimate prevalence ratios and their corresponding 95% CI. Structural Equation Modelling was used to conduct the mediation analysis.

Results: We observed a decline in prevalence of stunting (β=-0.20%; 95%CI: -0.43%, 0.03%), log-wasting (β=-0.02%; 95%CI: -0.02%, -0.01%), log-underweight (β=-0.02%; 95%CI: -0.03%, -0.01%) and anemia (β=-0.44; 95%CI: -0.55%, -0.34%), and an increase in LBW (β=0.06%; 95% CI: -0.10%, 0.22%) in West Africa over the period. Pooled prevalence of stunting, wasting, underweight, anemia and LBW in WA for the period 1985-2019 was 26.1%, 16.4%, 22.7%, 76.2% and 11.3%, respectively. Minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD), and HEQ mediated the association of low maternal education and poor household wealth with child undernutrition. Percentage mediation ranged from 20.3% to 26.6% for MDD, 6.4% to 14.2% for MMF, 24.2% to 33.5% for MAD, and 6.6% to 7.3% for HEQ.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: We provide the evidence base for assessing the effectiveness of national and regional interventions that have been implemented over the last four decades for tackling child undernutrition and LBW in West Africa. Evaluating existing interventions for effectiveness should be done through a socioeconomic lens if we are to address the high burden of child undernutrition in West Africa.

Keywords: Socioeconomic status, IYCF, Household environmental quality, Undernutrition, West Africa

OAB(T6)1-2

The Effect of Concurrent Anemia and Stunting on Cognitive Ability : A Longitudinal Study of Children in Indonesia

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Background and objectives: Anemia and stunting are nutritional problems that affect the cognitive abilities of school aged children in Indonesia. Concurrent anemia and stunting conditions can occur due to the characteristics of the child, mother and family environment. This study aims to asses the impact of concurrent anemia and stunting on children's cognitive ability.

Methods: We use two wave (2000-2007) longitudinal data from Indonesia Family Life Survey (IFLS). The subject of the study were 568 children aged 3-5 years old in 2000. Anthropometric data and hemoglobin level were collected for children at 3-5 years of age. Cognitive ability was measured with Raven Progressive Matrices, collected for children at 10-12 years of age. We used one-way annova to measured the frequency and correlation of cognitive ability with concurrent anemia and stunting. We also build linear regression models for multivariate analysis.

Results: Cognitive ability score of children with concurrent anemia and stunting was 11.72±3.30 (95% CI=11.12-12.31). The prevalence of concurrent anemia and stunting in this study was 21.65%. Concurrent anemia and stunting in early childhood were associated with head circumference, animal protein consumption, maternal education, father and mother's occupation and region of residence. Based on multivariate analysis, children with concurrent anemia and stunting have the lowest cognitive abilities compared to other groups and were statistically signitificant (p=0.031) after adjusted with children, parents and household factors.

Conclusions: Concurrent anemia and stunting at 3-5 years of age will increase the risk of low cognitive ability at 10-12 years of age. Therefore, nutritional and public health intervention to prevent low cognitive abilities and concurrent anemia and stunting not only focus on 1000 days of life but include children up to 5 years or more.

Keywords: Concurrent anemia and stunting, Cognitive ability, Early childhood, Stunting

OAB(T6)1-3

Micronutrient fortified milk consumption, vitamin D and socio-economic status in school age children in a rural region of Morocco

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Background and objective: Vitamin D deficiency is very common and affects about 50% of the world's population. The aim of this study is to determine the effect of micronutrient fortified milk consumption on vitamin D status among school age children.

Methods: Children aged 7 to 9 years participated in this double-blind longitudinal study were divided in 2 groups: a fortified group received daily 200mL of fortified UHT milk and a non-fortified group received 200mL of non-fortified UHT milk during 9 months. Socio-economic profile and anthropometric measurements were recorded. Blood samples were collected 3 times (at baseline, after 4 and 9 months).

Results: Our results showed that: 1- The majority of children's parents are illiterate, 72% of families consisted of 5 persons or more per household and 82.1% of families spent less than 120US$ per month for food; 2- 8.4% and 3.4% of children are stunted and underweight, respectively; 3- At baseline, 47.5% of the children had a 25(OH)D concentration <50nmol/L. 4- The consumption of fortified milk resulted a relative improvement in the prevalence of insufficiency of 64.2% after 9 months in the group consuming fortified milk compared to the group consuming non-fortified milk and the net gain improvement is 24.5% always favor the fortified group between the beginning and the end of the study.

Conclusion: The consumption of fortified milk has improved the vitamin D status and reduced its prevalence. It seems to be a good alternative for the improvement of vitamin D status among schoolchildren in Morocco.

Keywords: Vitamin D, Micronutrient, Fortification, Underweight, Children

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)1-4

School-based nutrition interventions had impacts on dietary diversity and meal frequency among adolescent girls in Ethiopia

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Background and objectives: Adolescence is a critical period of physical and psychological development, especially for girls as poor nutrition can affect their well-being as well as the well-being of their children. In Ethiopia, where the population is very young, evidence on the nutrition of adolescent girls and their determinants is scant. We tested the impact of a package of nutrition interventions delivered primarily through schools and implemented by Alive & Thrive (A&T) on the diet of adolescent girls.

Methods: We used a cluster-randomized trial design, comparing 27 primary school clusters in A&T intervention areas to 27 control schools in the SNNP and Somali regions. We surveyed adolescent girls (n=536) aged 10–14 years and enrolled in primary school grades 4-8, following at least one school semester (approximately 4 months) of implementation in March-April 2021. Using linear regression models, we tested for differences between program groups on dietary diversity, meal frequency, and consumption of unhealthy foods. In adjusted models, we controlled for age, household food security and wealth, and region.

Results: Dietary diversity score (1.4 food groups) and minimum dietary diversity (OR: 5.2) improved among girls in A&T schools compared to those in control schools. Among the food groups, there was significantly higher consumption of 5 groups in A&T areas: pulses, meats, eggs, vitamin A-rich fruits and vegetables, and other fruits. There was also a significant impact on meal frequency of 0.9 meals/snacks in the previous 24 hours, with girls in A&T areas consuming 4.0 meals/snacks out of 6 eating times compared to 3.2 in control areas. There was no impact on consumption of sweets, baked sweets, sweetened beverages, and fried and salty foods among girls, but there was lower consumption of sweets in the previous 24 hours in A&T (14%) versus control areas (23%).

Conclusions: Integrating nutrition interventions into primary schools in Ethiopia was feasible and achieved a significant impact on girls' dietary diversity and meal frequency. Reinforcing messages about eating better and more often resulted in incremental behavior change related to dietary diversity and meal frequency; however, telling adolescents not to eat junk foods without changing their food environments may be less successful in curbing consumption.

Keywords: adolescent nutrition, dietary patterns, school interventions, Ethiopia

OAB(T6)1-5

What Japanese children eat in school lunches: findings from the National Health Nutrition Survey 2012-2019

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Background and objectives: To promote the healthy development of children and attain favourable dietary habits, Japanese elementary and junior high schools provide uniformed school lunches for which the School Lunch Nutritional Standards are established for energy and several nutrients rather than food groups. This study aimed to show an overview of dietary intake from school lunches based on a nationwide survey over multiple years.

Methods: Participants were 5,244 elementary school students aged 6-12 years (ESS) and 2,201 junior high school students aged 12-15 years (JHSS) who participated in the National Health and Nutrition Survey 2012-2019 and reported having school lunches on the survey day. Dietary intake was estimated by a one-day semi-weighed household dietary record. The intake from school lunches was estimated based on the menu from each school, including information on names and weights of the ingredients. We estimated mean intakes of energy, nutrients, and food groups from school lunches and their contribution to total daily intake.

Results: Participants took one-third of daily energy intake from school lunches irrespective of age group and survey year. Regarding ESS, the school lunches contributed more than 40% in VA, VB_2, and Ca for nutrients with the Standards and in VD, VB_{12}, pantothenic acid, K (except for 2012 and 2017), and P but SFA (except for 2017 and 2018) for nutrients without the Standards throughout survey years. A similar trend was observed in JHSS, except for K and SFA with 40% contribution in the 2012-2014 survey only. No nutrients contributed to less than 30% of daily intake, except for MUFA in JHSS. For food groups, the contribution was varied from 5% for confectioneries to 85% for milk in both age groups. More than 40% contribution was observed in potatoes, pulses, nuts/seeds, vegetables, mushrooms, seaweeds, fish/shellfish, and milk, but in noodles, other grains, sugar/sweetener, and fat/oil throughout survey years (with some exceptions).

Conclusions: This study clarified that school lunches were successively and substantially contributed to dietary intake in Japanese children, even for some nutrients and food groups without the Standards. The present findings provided future directions for the improvement of school lunches in Japan.

Keywords: school lunch, children, Japan, National Health Nutrition Survey, evidence based policy making

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)1-6

Public management and social control - How to measure the quality of school feeding menus

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Background and objectives: Food quality indices, based on food guides and nutritional recommendations, allow evaluating the quality of diet groups and individuals, to compose actions to prevent diseases and promote food and nutritional security. The use of demanded objects, objective location for each country, target audience. The Quality Indicator for School Feeding Menus - IQCAE was created to evaluate school feeding menus within the scope of the National School Feeding Program - PNAE, considered the largest and most comprehensive food and nutrition program in Brazil. The IQCAE is the only validated instrument available in Brazil; however, guidelines indicated in consensus among specialists and changes in the normative instruments of the PNAE demand their revision. The aim of this study is to review the IQCAE.

Methods: Methodological study of a quantitative nature, carried out in three stages. The first involved: analysis of the current instrument, consensus study on healthy eating among experts, current legislation and limitations found after validation of the instrument. In the second phase, collaborators from the workshop Sustainable and Healthy School Meals – British Council UK, participated in the review of the IQCAE. Finally, the new proposal was presented to the research group and will be validated.

Results: The new version of the IQCAE includes eight daily assessment components and four weekly assessment components. The daily assessment components are food groups such as cereals and tubers; legumes; vegetables; whole; eggs, birds and fish; and dairy products. These components score positively, while the supply of sweets and ultra-processed foods score negatively. The weekly evaluation components depend on the frequency with which these foods are offered during the week and are intended to inhibit or encourage the consumption of these items in school meals, such as regional sweets and processed foods, time compatibility with type of meal and sustainability components. such as regional foods, socio-biodiversity and red meats. The IQCAE generates a maximum daily score of 16 points and varies from 0 to 100 points per week.

Conclusions: The review of the IQCAE allows us to affirm that the instrument will promote the incorporation of advances in regulatory mechanisms for the management of school meals, and knowledge about the pattern of food consumption on health. The inclusion of sustainability components represents another relevant improvement to what contributes to healthy eating.

Keywords: Quality index, School Feeding, Nutrition and food programs and policies, Public Management, Social Control

OAB(T6)1-7

The distribution and healthiness of foods sold around urban and rural schools in Kenya.

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Background: Urbanization and globalization of food production and marketing are two important factors fuelling the rise in the prevalence of obesity and non-communicable diseases in LMICs. The availability of food retail outlets around schools has been shown to influence food choices among school children. We estimated the density of food retail outlets around schools and the availability of healthy and unhealthy food options sold in the retail outlets in Kenya.

Methodology: This was a cross-sectional study conducted in three Kenyan counties (Nairobi-urban, Mombasa-urban, and Baringo-rural) from July 2021 to August 2021. Through multi-stage and population proportionate sampling approach,500 schools were selected from the three counties each stratified into high and low socio-economic status based on poverty indices from the Kenya National Bureau of Statistics All the food retail outlets within a radius of 250 meters around each school was mapped and the characteristics of all the foods sold in them were collected. NOVA classification was used to classify the foods according to healthiness into four categories (ultra-processed, processed culinary ingredients, and unprocessed foods).

Results: A total of 7792 outlets were mapped around the schools with a density of 25 (1-110), 19(1-47), and 3(1-17) for Nairobi, Mombasa, and Baringo counties, respectively. The most common types of outlets in the three counties were vegetable food stands at (30.21%), shops (25.19%), kiosks (13.6%), local vendors (13.4)%, and restaurants (7.34%). According to the NOVA classification, the unprocessed/minimally processed food category was the most common, n=15,657, (71.59%), followed by ultra-processed foods n=5483, (25.1%), processed culinary ingredients n=565(2.6%), and processed foods n=166, (0.8%).

Conclusion: Retail food outlets are common around schools in Kenya with a higher density in urban than in rural counties. Most of the foods sold around schools are healthy but there was also a substantial proportion of unhealthy food options such as ultra-processed foods. There is a need to develop policies to regulate the zoning of food retail outlets around schools to prevent exposure to unhealthy food options.

Keywords: Retail food outlets, Marketing, Children, Schools, Nutrition and food environment

Conflict of Interest Disclosure: Authors declare no conflict of interest

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)1-8

Extensive advertising of unhealthy foods around primary and junior high schools in the Greater Accra Region, Ghana

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Background and objectives: The advertising of energy-dense nutrient-poor food products is common in obesogenic food environments. The extent of advertising within surroundings where children live and play has the potential to influence their food choices. This study examined the extent and nature of advertising of foods, alcoholic and non-alcoholic beverages around selected schools in Ghana's most urbanized region, the Greater Accra region.

Methods: Basic schools (n =200) were selected using a multi-stage systematic sampling approach in six randomly selected districts of the Greater Accra region. This cross-sectional study assessed outdoor advertising around the selected schools using an adapted protocol from the International Network for Food and Obesity/Non-communicable Diseases Research, Monitoring and Action Support (INFORMAS). All outdoor advertisements (of food and non-food products)–within 250m road network distance from the entrance of all selected schools were photographed and geocoded. For each food advertisement, information was collected on the setting, type, and size of the advertisement, and promotional techniques used. All advertised food products were classified using the INFORMAS' as well as the NOVA food classification systems.

Results: A total of 5,887 advertisements were identified around the surveyed schools, 42% of which were for foods and beverages. Advertisements were most prevalent at food outlets (78% of all food advertisements) but also along roads, and on non-food structures. Overall, 70% of food advertisements featured non-core/unhealthy products, while 12% and 14% had core/healthy and miscellaneous (including soup cubes, seasonings, tea) products respectively. About 50% of the foods and beverages advertised were ultra-processed foods, 30% processed, 3% processed culinary ingredients, and 17% unprocessed or minimally processed foods. Sugar-sweetened beverages were the most advertised food product type (32%). Promotional characters were found on 14% of all food advertisements, most were cartoons/manufacturer's characters (69%). About 8% of all food advertisements had premium offers, including price discounts and gift/collectibles.

Conclusions: There is an abundance of unhealthy food advertisements around public basic schools in Accra. Policies and actions are needed to protect pupils from such marketing practices.

Keywords: outdoor advertising, unhealthy foods, schools, children

Conflict of Interest Disclosure: No conflicts of interest.

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OAB(T6)2-1

Periconceptional folic acid supplementation and the risks of small and large for gestational age at birth: the mediation effect of maternal homocysteine level during pregnancy

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Background and objectives: Some studies have demonstrated the protective effects of periconceptional folic acid supplementation (FAS) on the occurrence of small for gestational age (SGA). However, the effect of periconceptional FAS on the occurrence of large for gestational age (LGA) is still unclear. Besides, homocysteine (Hcy) concentration during pregnancy has found to be associated with birth weight. This study aimed to explore the independent effects of periconceptional FAS on the risks of SGA and LGA, and to test the potential mediation role of maternal Hcy during pregnancy on the above associations where a significant effect existed.

Methods: A large-scale prospective birth cohort was conducted among pregnant women from June 2018 to August 2019. Periconceptional FAS was evaluated by a self-administered questionnaire in early pregnancy. Neonatal birth weight was measured at delivery in the hospital. Maternal serum Hcy concentrations were measured in early and late pregnancy as part of the routine prenatal care. Logistic regression analyses were performed to assess the associations between FAS during preconception and/or early pregnancy and the occurrence of SGA or LGA. A mediation model was constructed to determine the role of maternal Hcy on the above associations.

Results: FAS before pregnancy (risk ratios [RR]=0.819, 95% confidence interval [CI]: 0.672-1.000, *P*=0.05), during early pregnancy (RR=0.622, 95%CI: 0.451-0.858) and from pre-pregnancy to early pregnancy (RR=0.564, 95%CI: 0.371-0.857) were associated with lower risk of LGA. However, no significant association was found between periconceptional FAS and SGA birth. Maternal Hcy concentration in late pregnancy mediated the independent effects of maternal FAS during preconception and early pregnancy on the risks of LGA birth.

Conclusions: Periconceptional FAS was associated with lower risks of LGA, which may be mediated by the reduced serum Hcy concentration in late pregnancy. The recommendation of periconceptional FAS should be complied with to achieve the optimal fetal growth.

Keywords: folic acid supplementation, small for gestational age, large for gestational age, homocysteine, mediation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: None
Further Collaborators: None

OAB(T6)2-2

Identifying factors to address multiple forms of malnutrition in Peru: a cross-sectional study of mothers and infants in low-income urban areas

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Background and objectives: Multiple forms of malnutrition coexist in Peru posing public health challenges. Hence, in order to identify opportunities for interventions, this study aimed to describe the coexisting forms of malnutrition at different levels: population, dyad (mother/infant) and individual (mother); and to investigate factors associated with coexisting forms of malnutrition at the dyad and individual levels.

Methods: A cross-sectional study was conducted amongst low-income urban mother-infant dyads (n=244) from Manchay (Lima) and Huánuco district (Huánuco) using a purposive quota sampling to recruit mothers with children 6-23 months. The main outcomes were dyad-level double burden of malnutrition (DBM) i.e., co-existence of maternal overweight/obesity and child anaemia and individual-level DBM in mothers i.e., co-existence of overweight/obesity and anaemia. Logistic regressions were performed to investigate socio-demographic and dietary factors associated with the DBM.

Results: Overall, 59.8% of mothers were overweight/obese and 34.0% were anaemic. Two maternal dietary clusters were identified: "varied, high fat, high sugar" and "high potato, low fruit and vegetables (FV), low red meat". Among children, 8.4% were overweight/obese and 61.5% were anaemic. At the dyad-level, the prevalence of DBM was 36.3%. Factors positively associated with dyad-level DBM included maternal age (aOR/five years: 1.41 [1.15-1.73]), having at least two children under five (aOR=2.44 [1.23-4.84]) and maternal work (aOR=1.73 [0.96-3.12]), although the confidence intervals (CIs) straddled the null for the latter. Living in Huánuco was negatively associated with dyad-level DBM (aOR=0.42 [0.24-0.74]). At the individual level, the coexistence of overweight/obesity and anaemia was 19.9%. Factors positively associated with maternal DBM included maternal age (aOR/five years: 1.35 [1.07-1.71]), parity (aOR=1.28 [1.05-1.55]), maternal work (aOR=1.86 [0.84-3.68]) and the "high potato, low FV, low red meat" cluster (aOR=1.92 [0.97-3.82]), although the CIs straddled the null for occupation and diet.

Conclusions: One third of dyads and approximately a fifth of mothers had concurrent overweight/obesity and anaemia. Double-duty actions that tackle multiple forms of malnutrition at the individual and dyad level are needed in low-income urban areas of Peru. Interventions that promote nutrient-rich diverse diets should be implemented and especially targeted at working mothers and their offspring as well as women with at least two children under five.

Keywords: multiple forms of malnutrition, women of reproductive age, infants and young children, urban poor, Peru
Conflict of Interest Disclosure: None
Further Collaborators: None

OAB(T6)2-3

The Effect of Breastfeeding to Accelerated Growth in Early Life : The Indonesia Family Life Survey 1997 and 2000

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Background and objectives: Accelerated growth in height and weight during early life is associated with the development of obesity and cardiovascular disease. Accelerated growth commonly occurs in malnourished children as a result of recovery from undernutrition. Some studies had found that breastfed infants who were born preterm or SGA at term had slower growth compared to non-breastfed children who had a higher risk for cardiovascular diseases. The purpose of this study was to investigate whether children who were not exclusively breastfed and experienced malnutrition in early life tend to have accelerated growth in height and weight.

Methods: We analyzed 3 years followed-up longitudinal study (1997-2000) from Indonesia Family Life Survey (IFLS). A total of 535 children aged 0 – 23 months in 1997 from 13 different provinces in Indonesia during the survey term were included in this study. Data on exclusive breastfeeding and mothers' characteristics were collected in 1997 and information on children's nutritional status was collected in both 1997 and 2000, to determine accelerated growth in height and weight. We divided children into 3 groups to compare the risk of accelerated growth between children with malnutrition in early life who were breastfed and non breastfed, compared to breastfed children without malnutrition occurrence. We used a multivariate-adjusted logistic regression model to estimate the odds ratio (OR) for accelerated growth among groups.

Results: The prevalence of accelerated growth in height and weight in non-breastfed malnourished children was 47,60% and 36,06%. The OR for accelerated growth in height of non-breastfed malnourished children was 8,41 (4,57-15,46) and the OR for accelerated growth in weight among them was 7,27 (3,67-14,40) compared with breastfed children, after adjusted with children's gender, mothers body mass index and education level.

Conclusions: Malnourished children who were not exclusively breastfed had a higher risk of accelerated growth in height and weight than breastfed children, many studies had

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

shown that accelerated growth in early life leads to metabolic syndrome in later life. Therefore, breastfeeding is a preventive strategy to protect the children, particularly those who were malnourished in early life, from the potential of accelerated growth that associated detrimental effects in adulthood.

Keywords: Accelerated growth, Exclusive breastfeeding, Malnourished Children

OAB(T6)2-4

Food voucher program improves the dietary outcome of children aged 6-59 months with moderate acute malnutrition in the Far North Region of Cameroon

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Background and objectives: Despite the high prevalence of moderate acute malnutrition (MAM) in Cameroon, there are limited national policy directives for its management. The study aimed to evaluate the effectiveness of a food voucher program (FVP) designed to treat MAM by supplementing usual diets, and examine the factors associated with dietary outcomes.

Methods: A longitudinal cohort study was carried out from March to August 2020 in the Kaele health district. Eligible children 6-59 months were identified through mass screening by community health workers (CHW) using mid-upper arm circumference (MUAC). Children identified with MAM (MUAC between 115 mm and 125 mm) were referred to health facilities for confirmed diagnosis and enrollment in the FVP. Study subjects were randomly selected using stratified sampling with probability proportional to the size of each health area. At enrollment and bi-weekly follow-up examinations, health agents provided caretakers a voucher to redeem for a pre-defined food basket (milk, eggs, fruits, vegetables, red millet flour, sugar and oil) from pre-selected local vendors. Complementary activities included discussions of recipes and child nutrition. Children's dietary intake was assessed at enrollment, then every two weeks until exit from the program upon a MUAC measure greater than 124 mm. Life table analysis was used to assess the cumulative probability of achieving the minimum dietary diversity (MDD) among children aged 6-23 months. Mixed effect logistic and linear regressions assessed factors associated with changes in MDD and dietary diversity score (DDS) among children 24-59 months of age.

Results: Among the 474 MAM children, the cumulative probability of meeting MDD increased from 19.9% at enrollment to 100% after 12 weeks, while mean DDS increased from 3.2 to 5.1 (95%CI: 4.6-5.7). Caregivers' perception of the safety of food items redeemed was positively associated with MDD increase (adjusted RR = 0.52; 95%CI: 0.30-0.82). Sharing of voucher foods with other family members was significantly associated with lower DDS (adjusted coef. = 0.33, p = 0.047).

Conclusion: The FVP was associated with improved dietary diversity of MAM children in the Far-North of Cameroon. Perceptions of food safety appears to influence dietary intake, even in contexts of high food insecurity.

Keywords: Dietary, diversity, food, voucher, program

Conflict of Interest Disclosure: Ismael Teta, Jennifer Nielsen, Djeinam Touré and David Doledec are staff of Helen Keller Intl that received the grant from USAID/OFDA to conduct the research. However, they were not involved in the funding decision. The remaining authors have no conflicts of interest to declare.

OAB(T6)2-5

Impact of Behavioural Change Communication on the Knowledge and Child Survival Practices of Mothers of Under-Five Children in South-West Nigeria

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Background and objective: Behavioural Change Communication (BCC) is useful in promoting positive health outcomes through several models. However, its potential in promoting Child Survival (CS) practices remains understudied. Furthermore, poor child survival practices among mothers of under-five children have greatly contributed to the leading causes of child deaths in Nigeria. The study was conducted to evaluate the impact of BCC on knowledge and child survival practices of mothers of under-five children in Southwestern, Nigeria.

Methods: Cluster randomized design involving a four-stage sampling technique was adopted to sample mother-child pairs from 654 households in Oyo, Ogun, and Ekiti States of Nigeria. The 654 (218 per state) were randomly assigned to the Experimental Group (EG) (327) and Control Group (CG) (327). The experimental group was exposed to six sessions of BCC and followed up using an inter-personal communication approach for six months. Pre-tested, interviewer-administered, semi-structured questionnaires containing 12-point knowledge and 13-point practice scales were used to assess mothers' knowledge and practices of CS. The CS components measured were newborn care, breastfeeding, complementary feeding, micronutrient supplementation, immunisation, management of sick children, and use of mosquito nets. Data were analysed using descriptive statistics and paired students' t-test at $\alpha_{0.05}$.

Results: Mean Ages of mothers and children were 31.19±6.1 years and 31.49±15.9 months respectively. Mothers' knowledge of CS components significantly increased from 4.5±3.0 at

baseline to 10.2±1.8 for EG and increased from 4.9±2.1 to 5.3±2.1 for CG. Mothers' practice of CS increased from 3.96±2.13 at baseline to 12.9±2.4 for EG and from 3.8±2.1 to 3.9±2.1 for CG. There was an improvement of 5.64±3.37 and 8.94±3.17 for mothers' knowledge and practices respectively. A large effect of BCC (0.74, 0.89) on the knowledge and practices of mothers of the under-five children was revealed in the study.

Conclusion: Behavioural change communication through interpersonal communication has improved mothers' child survival knowledge and practices and its use is thereby recommended for promoting child survival practices among mothers of under-five children.

Keywords: Behavioural change communication, Interpersonal communication approach, Child survival , Knowledge, Practices

OAB(T6)2-6

Maternal factors and dietary diversity in relation with *stunting* among under-5 children: analysis of mother-child pair data of Indonesia basic health survey 2018

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Background and objectives: Indonesia are now still suffering from high prevalence of child stunting. Maternal factors play a significant role in the prevention of stunting which need to be addressed. Additionally, dietary diversity also predicts the adequacy of nutrients that could prevent stunting. This study aims to understand the maternal factors and dietary diversity as a risk of child stunting in Indonesia.

Methods: A cross-sectional, secondary analysis using mother-child pair data from Indonesia health survey 2018 was done in this study with total sample of 73,691 paired data. Maternal characteristic collected by interviewing of structured questionnaire. Maternal height and mid-upper arm circumference (MUAC) were collected using direct measurement, while dietary diversity was measured based on the type of food group intake in the last 24 hours which consists of 9 food groups. Stunting was retrieved from Height-for-Age Z-score (HAZ) using WHO Anthropometry software based on direct measurement of length/height. Data then analyzed using logistic regression to get the magnitude of risk for each variable tested with significancy at $\alpha < 0.05$.

Results: Stunting prevalence was found at 27.4, significantly higher in boys. Maternal characteristic that correlated to stunting were mother's age *p*< 0.000; OR = 1.736; 95% CI 1.718 – 1.755), age of first pregnancy (*p*< 0.000; OR = 0.040; 95% CI 0.030 – 0.050), total parity (*p*<0.000; OR = 1.725; 95%CI 1.716 – 1.733), mother's education (*p*< 0.000; OR = 1.216; 95% CI 1.200 – 1.233), mother's working status (*p*< 0.000; OR = 1.898; 95% CI 0.891– 0.925), adherence of iron-folic acid (IFA) tablet consumption (*p*< 0.000; OR = 1.683; 95% CI 1.677 – 1.689), mother's stature (*p&lt* ;0.000; OR=6.31; 95% CI – 6.00 – 8.00), and mother's MUAC (*p*< 0.000; OR = 0.120; 95% CI 0.120 – 0.130). Dietary diversity was also significantly higher in non-stunted children compared to stunted children (p=0.031; OR = 1.646; 95% CI 1.641 – 1.650).

Conclusion: In conclusion, we found highest risk factor of stunting was mother short stature, working status and adherence to consume IFA. This study implies that prevention of stunting prevention should start as early as possible by preparing the nutritional status of childbearing age women or before pregnancy starts, as well as the need for monitoring IFA consumption compliance.

Keywords: dietary diversity, Indonesia, malnutrition, maternal height, stunting

Conflict of Interest Disclosure: We have no conflicts of interest to report for this study.

Further Collaborators:

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OAB(T6)3-1

The impact of COVID-19 on vitamin A supplementation coverage among children aged 6-59 months in four countries in Sub-Saharan Africa

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Background and objectives: Vitamin A supplementation (VAS) for children aged 6-59 months occurs mainly during semi-annual health events in Sub-Saharan Africa (SSA). Infection prevention measures and community sensitization were integrated into campaigns during the COVID-19 pandemic to reduce risk of transmission and mitigate reticence to health service delivery at home. This study explored the impact of socio-demographic factors, COVID-19 concerns and behavioural modifications on VAS coverage in four countries in SSA.

Methods: Data from eight nationally-representative household post-event coverage surveys (n=~27,700) using a cross-sectional cluster study design and conducted in Burkina Faso, Côte d'Ivoire, Guinea and Mali were used to compare changes in VAS coverage between 2019 and 2020. Data were

collected from primary caregivers of children aged 6-59 months. Descriptive statistics and adjusted multi-variable logistic regression models examined the effects of rural vs. urban residence, child sex, child age, caregiver education, household wealth status, and levels of concern regarding COVID-19 on child VAS status.

Results: Between 2019 and 2020, VAS coverage increased in Burkina Faso (82.2% to 90.8%), Côte d'Ivoire (87.0% to 93.3%), and Mali (76.1% to 79.3%), and decreased in Guinea (86.0% to 82.3%). In the 2020 models, children living in rural areas had a higher likelihood of VAS compared to children in urban areas in Burkina Faso (aOR = 4.75; 95% CI: 3.52, 6.40), Côte d'Ivoire (aOR = 5.19; 95% CI: 3.10, 8.70) and Mali (aOR = 1.41; 95% CI: 1.15, 1.74). Children aged 12-59 months had a higher likelihood of VAS compared to children aged 6-11 months in Côte d'Ivoire (aOR = 1.67; 95% CI: 1.12, 2.48) and Mali (aOR = 1.74; 95% CI: 1.34, 2.26). A moderate to high level of concern regarding COVID-19 was associated with a lower likelihood of VAS in Côte d'Ivoire (aOR = 0.55; 95% CI: 0.37, 0.80).

Conclusions: The higher VAS coverage observed in 2020, as compared to pre-pandemic levels, in three of four countries suggests that COVID-19-related caregiver concerns and behavioural modifications may not have been limiting factors to uptake of VAS in some countries in SSA where campaigns incorporated measures to reduce risk and sensitize communities.

Keywords: Sub-Saharan Africa, vitamin A supplementation (VAS), children, COVID-19

Conflict of Interest Disclosure: The authors have no conflict(s) of interest to declare.

OAB(T6)3-2

Impact of COVID-19 pandemic on children food security and nutrition: results of the 2021 Student Evaluation Survey conducted by the Mexican National System for the Integral Development of the Family

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Background and objectives: Mexico has been severely impacted by the COVID-19 pandemic. As of April 2022, 324,033 total deaths directly related have been reported. In 2021, the National System for the Integral Development of the Family (SNDIF), which is the government agency responsible for the implementation of Food Social Assistance Programs, studied the impacts of the pandemic in children's food security and nutrition through its Student Evaluation Survey (SES). The first SNDIF SES was conducted in 2018. Therefore, the 2021 SES has a baseline for comparison. The objective of the study is to determine if factors associated with the pandemic such as head of household illness and/or death and loss of employment or economic stability, modified the following indicators: a) growth, b) food security, and c) diet. It is expected that the evidence of this study will inform policy making.

Methods: This work is a longitudinal, prospective and analytical study of a cohort of primary school children, aged between 5 and 13 years. Two standardized and validated questionnaires were created, together with digital and physical data collection forms. Questions were harmonized with the Mexican National Health and Nutrition Survey indicators for comparability. One questionnaire was directed to parents and tutors and the other to students enrolled in the public education system. The questionnaires included modules on: identity and geolocalization, anthropometric measures, food security, food intake, sleeping habits, physical activity, household employment status, household deaths directly related to COVID-19, and food assistance programs. Due to sanitary restrictions, data collection was carried out physically and virtually by SNDIF personnel, parents, teachers and government health workers between May and September 2021. A total of 1,096 million completed forms were received, and 816,000 questionnaires were valid for analysis. In the case of anthropometric measurements, a nutritional status was determined according to weight-for-age Z-score, height-for-age Z-score, and BMI-for-age Z-score.

Results: 27 out of the 32 States participated in the survey. A quarter of the households surveyed reported that at least one member of the family had COVID-19, the main family members who became ill were the father (12.3 %) and the mother (9.3%). Moreover, 6.3% of the households reported at least one death in the family related to COVID-19. Of the 200,269 children at risk of food insecurity, 42% receive some support for food. Trends in nutritional status have changed compared to before the COVID-19 pandemic. In general, the prevalence of malnutrition increased. 23.27% of children measured present obesity, compared to 11.91% in 2019 ; 21.10% present overweight, compared to 22.03% in 2019; and 17% present some type of undernutrition, compared to 13.62% in 2019.

Conclusions: The COVID-19 pandemic and its associated factors have had effects on the status of food security and nutrition in children ages 5-13 enrolled in the public education system. All forms of malnutrition are still of concern, being obesity the one that has higher increase rates between 2018 and 2021. Policy measures need to be taken by the SNDIF to adjust Food Social Assistance Programs to the current food security and nutrition context.

Keywords: Mexico, Pandemic, Children Nutrition, Public Health, Food Policy

Further Collaborators: The Authors declare that there is no conflict of interest. Partial funding came from FAO Technical Cooperation Programmes (TCPs). Funds for TCP projects come directly from the dues paid by FAO members.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)3-3

Unhealthy food products marketed to Mexican children and adolescents on the internet during the COVID-19 pandemic

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Background and objectives: Marketing exposure triggers consumption of unhealthy foods. In the last decade, the use of the internet has risen, along with digital marketing of foods and beverages. During the COVID-19 pandemic, school changed from face to face to virtual lectures and other activities became virtual. The objective of this study was to determine the healthfulness of foods marketed to children and adolescents on the internet during the COVID-19 pandemic.

Methods: In this cross-sectional study we used a crowdsourcing strategy to recruit participants aged 6 to 19 years old. Those with Wi-Fi at home and with enough storage space on their devices uploaded videos of their internet exposure. Trained dietitians performed a content analysis using the protocol of the World Health Organization (Europe Office). For all products advertised, we collected nutrition information, mostly from the products' official websites and from Mexican supermarket websites. All information was recorded into calories or grams/100 grams. To determine if the advertised products were unhealthy, we used the PAHO Nutrient Profile Model (NPM) and the Mexican front of package label NPM.

Results: We received recordings from 347 children and adolescents. Overall, 69.5% of participants were exposed to food digital marketing. The most frequently marketed food categories were: ready-made foods (23%), cakes and biscuits (14%), chocolate, energy bars and desserts (12%), savoury snacks (7%), sugar sweetened beverages (7%), edible ices (6%), breakfast cereals (4%), among others. According to the PAHO, 93.3% of the promoted products had at least one excess nutrient of concern and 61% exceeded the total fat cut-off point. The Mexican NPM classified 8.7% of the promoted products with zero warning labels, while 91.3% were classified with at least one warning label. Half of the products exceeded the saturated fat cut-off point.

Conclusions: Most of the children and adolescents were exposed to unhealthy food digital marketing and most of the products that were marketed on the internet were classified as unhealthy according to the PAHO and the Mexican NPM. This evidence shows the need to enforce strong regulations targeted at digital media that protect children and adolescents from the food industry's tactics.

Keywords: Food marketing, Digital marketing, Children and adolescents, Unhealthy food digital marketing

Conflict of Interest Disclosure: This project was funded by Bloomberg Philanthropies and UNICEF Mexico. The presenting author was funded by CONACYT Mexico and was awarded with the Healthy Food Policy Fellowship.

OAB(T6)3-4

Balanced Nutrition practiced with limitations during the COVID-19 pandemic: The experience of parents in Subang, West Java, Indonesia

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Background and objectives: Food-Based Dietary Guideline (FBDG) is adopted worldwide. Messages that are found across many countries are to consume a variety of foods; consume fruits and vegetables, legumes, and animal-source foods; and limit sugar, fat, and salt. In Indonesia, the FBDG is translated into ten Balanced Nutrition messages, which was released by Ministry of Health in 2014. The purpose of the study is to assess the knowledge on these messages and practices among parents of preschoolers in Subang district, West Java province, before and during the COVID-19 pandemic (before March 2020 vs. October 2021) and to seek differences in the knowledge and practices of parents who attended nutrition training and those who did not attend any nutrition training.

Methods: Google online survey platform was used to collect the data.

Results: Most of the respondents were female (n=71) with age range between 21-49 years. About half of the parents were high school graduates. The top three Balanced Nutrition messages mostly selected by the parents were drink adequate and safe water (85%), consume variety of staple foods (75%), and eat plenty of vegetables and fruits (73%), while the least selected were enjoy variety of foods (42%) and reading food labels (35%). An increase was found in parents who drink adequate water and conduct physical exercise daily during the pandemic, as well as those who wash hands. A decrease was found in parents who consumed fruits, vegetables, and animal protein daily, with statistical difference for vegetables and animal protein. Majority (61%) of the parents perceived that their food quality was poorer during the pandemic and 37% experienced food shortage. Majority (72%) had decreased income, 51% decreased their food expenditure, and 60% (n=52) decreased smoking expenditure. About half (48%) of the parents participated in some kinds of nutrition training in the last four years. The trained parents mentioned more of the Balanced Nutrition Messages, with a gap up to six percentage points.

Conclusions: Parents acquired knowledge on nutrition to some degree, but its application faced limitations during the pandemic. Dissemination of Balanced Nutrition can be done through pre-school teachers.

Keywords: Balance Nutrition, Knowledge, Practice, Training, Indonesia

Conflict of Interest Disclosure: The authors have no conflict of interest

OAB(T6)4-1

Are current nutrition policy actions and frameworks equipped to transform food systems? Analysing worldwide regulatory interventions using a framework for ecological regulation.

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Background and objectives: Today's global food systems are contributing to multiple intersecting health, social and environmental crises. Experts and authoritative organisations are calling on governments to take policy action to transform food systems, including using regulatory interventions. Ultra-processed foods (UPFs) merit regulatory attention as substantial evidence shows that UPF consumption harms human health, and increasing evidence points to significant environmental impacts linked to UPF supply chains. The global rise of UPF production and consumption is tied to the industrialisation of food systems, sustained by multiple determinants (e.g., globalised food supply chains, the market power of transnational UPF corporations). To date, few researchers have examined the transformative potential of regulatory interventions and nutrition policy frameworks to tackle the UPF problem and related socio-ecological crises. The objective of this study is to critically examine whether current nutrition policy actions and policy frameworks are compatible with 'ecological regulation', an approach that reorients regulatory tools to socio-ecological goals, in order to transform food systems.

Methods: We conducted a qualitative documentary analysis of national policies from multiple countries, using an integrated theoretical framework that draws on ecological regulation and systems science analyses on leverage points for systems change. We focused on regulatory interventions relevant to nutrition from a whole-of-food-systems perspective. Interventions were analysed in NVivo using codes developed for the integrated framework and also existing nutrition policy frameworks.

Results: Findings suggest that regulatory interventions and nutrition policy frameworks predominantly consider isolated elements of the food system (e.g., food prices, labels) and use a limited range of regulatory tools (e.g., taxes, front-of-pack rating systems). Analysis indicates that they do not adequately address the system's paradigms and goals (e.g., dominant market-based and nutrient-centric ideologies), the synergies or trade-offs among interventions, or the commercial, political, social and environmental dimensions of food systems problems.

Conclusions: Results indicate that the system's paradigms and goals are arguably the most influential places to intervene to generate whole-of-food-systems change, yet appear to be insufficiently targeted in policy actions and frameworks. This study highlights the potential for an ecological approach to regulation, informed by systems science analyses, to contribute to global food systems transformation.

Keywords: food systems, ultra-processed foods, systems thinking, food policy, food regulation

OAB(T6)4-2

Automating the collection and processing of data for the creation of a comprehensive food composition database by brand name - the Food Label Information Program (FLIP)

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Background and Objectives: Monitoring the nutritional quality of national food supplies is key to nutritional research, policy development, and monitoring. The Food Label Information Program (FLIP) is a big data approach to the collection and evaluation of brand-name foods in Canada and Latin American countries (LAC). This study describes the automated approach used for FLIP 2020 updated data collection and analysis.

Methods: The University of Toronto's FLIP is a longitudinal cloud-based database of brand name prepackaged foods and beverages collected since 2010 in Canada and since 2015 in LAC. FLIP 2020, used website "scraping" to collect food label information on all foods and beverages available on 7 major Canadian grocery retailer websites. Each website was scanned for an outline of how product information was stored. Using Python-based routines, hyperlinks of product pages were loaded and data extracted into FLIP. Artificial Intelligence-enhanced Optical Character Recognition (AI-OCR), coupled with Machine Learning (ML) and text parsing algorithms were used to locate and process specific text which was extracted from product images, such as ingredients, Nutrient Facts tables, and product identification information. A modified pre-trained BERT model was used to encode texts from the product name, ingredients and brand information for predicting food categories according to Health Canada's table of reference amounts (TRA).

Results: Overall, accuracy of ML/AI-OCR techniques depended largely on the quality of images and consistency of text formatting. Accuracy was >95% when the images were of good quality. The precision of TRA categorizations ranged from 0.93 to 1; 0.99 for desserts, 0.98 for cereals, dairy, fats and oils, water animals, soups, and 0.97 for beverages, fruits, vegetables, snacks, meat, sauces, and combination dishes.

Conclusions: FLIP, with its comprehensive sampling and use of AI-OCR, is a powerful tool for more frequent and extensive evaluating and monitoring food supplies and allows more efficient sampling and processing of large amounts of data. As not all retailers provided all the mandatory food label information on their websites, regulators will need to ensure that consumers have access to mandatory information found of food labels when shopping online, which will aid automated monitoring of the food supply.

Keywords: food database, automation, food composition, public health, nutrition policy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)4-3

The Choices International criteria: a nutrient profiling system to classify food products into 5 levels of healthiness

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Background and objectives: Food-based dietary guidelines provide a conceptual basis to guide food choices and nutrition policies, but they may not always consider processed food products. Advanced, global, and graded nutrient profiling systems (NPSs) can overcome this limitation and support nutrition policies to prevent and control non-communicable diseases. However, graded NPSs that use an across the board and scoring algorithm are not easily adaptable to specific contexts. This paper examines whether the Choices single-level NPS, which is product group-based and uses thresholds, can be extended to a graded NPS and support a variety of nutrition policies.

Methods: The Choices International Foundation revised its single-level criteria from 2020 by extending them into a 5-level nutrient profiling system (NPS). Four thresholds were determined using a series of benchmarks, including compliance levels calculated in an extensive international food product database, the aforementioned Choices criteria, and NPSs developed by the WHO to restrict marketing to children. Validation consisted of comparison with indicator foods from food-based dietary guidelines from various countries in Europe, Africa, and Asia. Furthermore, the new NPS was compared with the Health-Star Rating and Nutri-Score systems using products from multiple countries.

Results: A 5-level NPS was developed for 33 food product groups and expressed as grams of saturated fat, trans fat, sugar, sodium, and fiber per 100 g of a food product. It can support a variety of nutrition policies such as restricting marketing to children, front of package nutrition labeling, reformulation, taxation, subsidies, etc. As the Choices 5-level NPS is product group-specific and uses thresholds rather than a scoring system, it can be easily adapted to different contexts. In comparison with other NPSs, the Choices 5-level NPS gives a more accurate representation of dietary guidelines.

Conclusions: The new Choices NPS were developed in particular to create a coherent set of public health measures to promote healthier food. The Choices International criteria can be applied to different contexts and support a variety of nutrition policies.

Conflict of Interest Disclosure: None.

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Keywords: Nutrient profiling system, Nutrition policy, Dietary guidelines, Non-communicable diseases

OAB(T6)4-4

Which front-of-package label works best to help adolescents make healthier food purchases? A randomized choice experiment in Indonesia

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Background and objectives: Front-of-package labels (FOPLs) are a promising population-level strategy to inform consumers and discourage unhealthy food purchases, but little research has examined their impact in adolescent populations. We conducted choice experiments to test the effect of a traffic light label (TLL) and warning label on Indonesian adolescents' ability to identify unhealthy products and their intentions to purchase them.

Methods: Data were collected from 1,871 adolescents in Indonesia. Participants were randomized to one of the following study arms: 1) a control label (barcode); 2) TLL (color-coded label with numeric nutritional information; or 3) a warning label (black diamond with text 'high in sugar/salt/fat and/or saturated fat'). Participants viewed a set of two products from four categories (tea, cereal, cookies, and yogurt), which included one less healthy option and one healthier option. Products displayed the FOPL according to the assigned study arm. Participants were asked to identify which product was less healthy, which had an excess of critical nutrient(s), and which they preferred to buy. We used a mixed effects linear regression model for continuous outcomes and mixed effects logistic regression for binary outcomes.

Results: In the choice experiment, participants exposed to TLL or warning label were more likely to identify the less healthy product, with 45.1% in the control group correctly selecting the less healthy product compared to 50.5% and 51.9% in the warning and TLL groups, respectively ($p<0.01$). Relative to the control group (53.5%), the warning label and TLL also led to a higher percentage of participants who correctly identified which product was higher in sugar (57.9% and 58.4%, respectively; $p<0.01$ for both comparisons). Relative to the control group (62.6%), only the warning label led to a lower percentage of participants who selected the less healthy product as the one they wanted to buy (58.9%, $p=0.010$). For all three outcomes, there was no statistically significant difference between the traffic light vs. warning groups.

Conclusion: Warning labels and TLLs both influenced Indonesian adolescents' ability to identify unhealthy products and reduced intentions to consume them, with the pattern of

results suggesting that the warning label was slightly more effective.

Keywordss: Front-of-package label, Adolescent nutrition, Warning labels

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T6)4-5

Sanitation, food safety, and hygiene are suboptimal in public sector basic schools in the Greater Accra Region, Ghana: field observations and perspectives of food service providers.

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Background and objectives: School feeding programmes (SFPs) have real potential to improve educational achievement, promote child health, and human capital development. Ghana has been implementing its SFP for over a decade, albeit with several systemic and operational challenges.

The study sought to assess food safety and hygiene practices among school caterers and food vendors (FVs) in selected public sector basic schools participating in the Ghana's SFP.

Methods: The sample included 660 FVs and 129 caterers from 169 schools implementing the SFP in six districts of the Greater Accra Region. Direct observation was used to locate FVs within the immediate premises of the schools. Interviews were conducted with FVs, and caterers involved in the SFP. Descriptive analyses were performed to generate absolute and relative frequencies. Notes from field observations and perspectives of food service providers are presented narratively.

Results: More than three-quarters of caterers and over half (59%) of FVs reported receiving certification from a regulatory body to provide or sell food respectively. Around half of caterers had been medically certified to sell food, versus more than three-quarters of FVs, although only 16% provided evidence of this. Only 42% of FVs and 15% of caterers reported having ever received training on food safety and hygiene. One in four FVs declared having never been visited by food inspectors from regulatory bodies to assess food hygiene and safety. One in two FVs reported lack of water (54%) and soap (61%) for handwashing at vending sites. Almost half (48%) of FV and a quarter (23%) of caterers did not adequately protect food from environmental contaminants; uncovered organic waste was found near 71% of FV sites. About a third (32%) of FVs did not have adequate sanitary conditions at their vending sites.

Conclusions: Environmental sanitation, food safety and hygiene practices, and regulatory compliance were suboptimal. Most FVs and caterers did not receive adequate training on food safety and hygiene issues. Current food safety legislation needs to be implemented more rigorously through a combination of different actions.

Keywords: food environment, schools, food safety, food vendors, Ghana

OAB(T6)4-6

Micronutrient adequacy of women's diets in rural Kenya and Uganda: Implications for culturally acceptable food-based recommendations and improving access to nutrient-dense foods in local food environments

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Background and objectives: Micronutrient deficiencies in women-of-reproductive-age (WRA) persist in sub-Saharan Africa (SSA). Our aim was to (i) estimate the percentage of rural WRA at risk of micronutrient inadequacies in select districts from two SSA countries, (ii) propose food based-recommendations to improve micronutrient adequacy, (iii) identify 'problem' micronutrients that would be difficult to address based on current dietary patterns, and (iv) explore nutrient-dense food sources in local food environments.

Methods: Dietary intake was assessed for lactating women from Western Kenya (n=286; 2014) and pregnant, lactating, and non-pregnant/non-lactating (NPNL) women from Eastern Uganda (n=201; 2018) using 24-hour dietary recalls and weighed food records, respectively. The percentage at risk of inadequate micronutrient intakes was estimated with the Intake Modelling Assessment Planning Program. Linear programming analysis using Optifood software was used to identify problem micronutrients and formulate food-based recommendations.

Results: Micronutrient adequacy was poor. In Uganda, over 87% pregnant, 66% lactating and 53% NPNL women were at risk of inadequate intakes for 7,6, and 5 micronutrients respectively, with inadequate intakes of iron, calcium, and vitamin A greater than 79% for each group. In Kenya, over 83% lactating women were at risk of inadequate intakes for 6 micronutrients, with inadequate intakes of iron, calcium, riboflavin, and folate over 95%. Modelling indicates that increased consumption of whole

grains, legumes, dark green leafy vegetables, orange-fleshed sweet potatoes, milk, and small dried fish could help close the micronutrient gap. In Uganda, most of these foods were procured from informal street vendors or weekly markets.

Conclusions: Preliminary findings indicate that food-based approaches to improve micronutrient intake through increased consumption of local, culturally acceptable foods holds promise in rural WRA, yet research is needed on the seasonal availability and affordability of these nutrient-dense foods. Results also highlight the importance of supporting the informal food environment for ensuring access to a nutrient-dense diet during food environment transitions in rural, low-resource settings. However, a realistic food-based approach (based on current dietary patterns) alone will not eliminate the percentage of WRA at risk of inadequate intakes of iron and calcium, indicating that holistic interventions including biofortification and behaviour change may be required.

Keywordss: micronutrient adequacy, food-based recommendations, food environments, women of reproductive age, linear programming

Conflict of Interest Disclosure: Lydia O'Meara is a PhD candidate supported by Research England through the Food and Nutrition Security Initiative (FaNSI) at the University of Greenwich. This funding does not in any way influence the research findings.

OAB(T6)5-1

Trend in the prevalence of anemia in childbearing Mexican women during the last fifteen years

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Background and Objective: Globally, around 30% of women and children under the age of 5 are affected by the anemia, nearly 800 million people. In the last two decades, anemia has improved by only 0.2 to 0.3 percentage points per year. In Mexico, recent data on anemia in women of childbearing age, emphasize that is a public health problem. The purpose of this study is to analyze the trend in the prevalence of anemia during the last 12 years (from 2006 to 2018-19) in non-pregnant Mexican women aged 20 to 49 years old.

Methodology: Data from three National Health and Nutrition Surveys [ENSANUT] were used. ENSANUT is a nationally representative probabilistic multistage stratified cluster sampling survey (representative at regional (four regions) and urban/rural level), and it has a methodological design that allows comparisons between them. All the series of ENSANUT (2006, 2012 and 2018-19) were conducted from September to May. The capillary hemoglobin (Hb) sample size for Ensanut 2006 was 20,480 women (rate response (RR)=80%); for Ensanut 2012 of 18,118 women (RR=78%), and for Ensanut 2018-19 of 8,283 women (RR=85%). Capillary drop Hb was measured in the portable photometer Hemocue 201+ and anemia categories were defined as anemia: Hb <12.0 g/dL, moderate anemia: Hb 8.0-10.9 g/dL and severe anemia: Hb <8.0 g/dL, adjusted for altitude. Logistic regression models were used to identify the change over time of survey in the odds for anemia categories.

Results: The prevalence of anemia in Mexican women adjusting by residence area (urban/rural), wellbeing condition index, and education level decreased by half in 6 years (ENSANUT 2006, from 26.6% to 13.3% in 2012, p<0.001). From 2012 to 2018-19, it has a significant increase of 5.8 percentage points [pp (19.1%?)], p<0.05. In the 2018-19 survey the highest prevalence of joint moderate and severe anemia (10.0%) was found compared to 2012 (3.9%, p<0.001) and 2006 (5.8%, p<0.05).

Conclusion: Anemia affects 1 in 5 Mexican women aged 20 to 49 in 2018-19. Nevertheless, caution in the interpretation of this increase is recommended since we cannot discard measurement errors in Hb capillary determination. COVID-19 increased malnutrition and maternal mortality limiting progress towards meeting the 2025 World Health Assembly nutrition targets. Therefore, identifying the main causes of anemia in this population is necessary to opportunely intervene either through diet, food fortified, or micronutrient supplementation in those women at higher risk.

Keywords: anemia, hemoglobin, women, national survey

OAB(T6)5-2

Prospective associations of overall and specific carbohydrate intake with anxiety status evolution: findings from the NutriNet-Santé population-based cohort

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Background and objectives: There is cross-sectional evidence for the association between carbohydrate intake and anxiety, however, population-based prospective data are lacking. Thus, we investigated the prospective associations between carbohydrate intake from various sources and anxiety status evolution in a large sample recruited from the general population.

Methods: We included 15,602 participants (73.8% female; mean age=53.8 ± 13.1 years) of the French NutriNet-Santé web-cohort who completed the trait subscale of Spielberger's State-Trait Anxiety Inventory (STAI-T) once at baseline (2013-2016) and once at follow-up (2020). High general anxiety was defined

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

as STAI-T score >40 points. Participants were categorized in four groups according to baseline and follow-up anxiety status: 1) None= absence of high general anxiety at any time point; 2) Transient= high general anxiety only at baseline; 3) Onset at follow-up= high general anxiety only at follow-up; 4) Persistent= high general anxiety at baseline and follow-up. Carbohydrate intake was estimated from ≧2 self-administered 24-h dietary records completed within a 2.5-year window around the baseline STAI-T assessment date. Polytomous logistic regression models assessed the associations between quartiles of overall and specific carbohydrate intake and anxiety status.

Results: The mean follow-up time was 5.4 ± 0.9 years; carbohydrate intake was estimated from 8.7 ± 3.8 24-h dietary records. The fully-adjusted models revealed that sweetened beverage intake was associated with higher odds for Transient anxiety (OR_{Q4vsQ1}=1.11 (95% CI 1.02-1.21); p_{trend}<0.02). Intakes of complex carbohydrates (OR_{Q4vsQ1}=1.12 (95% CI 1.01-1.25); p_{trend}<0.02) and starch (OR_{Q4vsQ1}=1.13 (95% CI 1.02-1.25); p_{trend}<0.01) were associated with higher odds for anxiety Onset at follow-up. Percentage of energy from carbohydrates (OR_{Q4vsQ1}=1.11 (95% CI 1.03-1.19); p_{trend}<0.02), intakes of total carbohydrates (OR_{Q4vsQ1}=1.10 (95% CI 1.03-1.18); p_{trend}<0.02), complex carbohydrates (OR_{Q4vsQ1}=1.09 (95% CI 1.02-1.17); p_{trend}<0.01), and starch (OR_{Q4vsQ1}=1.09 (95% CI 1.01-1.16); p_{trend}<0.02) were linked to higher odds for Persistent anxiety. Finally, 100% fruit juice intake showed lower odds for Persistent anxiety (OR_{Q4vsQ1}=0.87 (95% CI 0.81-0.94); p_{trend}<0.01).

Conclusions: This large, prospective study found significant associations between different measures of dietary carbohydrate intake and anxiety status evolution among French adults. The findings could guide dietary interventions aimed at anxiety prevention and management.

Keywords: dietary carbohydrate, epidemiological study, mental health, prospective analysis, trait anxiety

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T6)5-3

Association of two Nova-scores of diet quality with weight gain in the Nutrinet-Brasil cohort

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Background and objectives: The evaluation of the performance of simple dietary metrics on comorbidities with high occurrence in the population may contribute to policymakers. We assessed two dietary scores based on the Nova (a name, not an acronym) food classification system, with weight gain.

Methods: The NutriNet-Brasil study (2020-2022) is a web-based prospective cohort. More than 100,000 volunteers have already subscribed to the digital platform of the study. This analysis included 9,544 participants aged 18 years or older who self-reported their height at baseline and body weight at baseline and 14-month follow-up (mean follow-up: 15.2 months). The outcome was excessive body mass index (BMI) gain (≧ 5%) from baseline to follow-up. Dietary intake was assessed at baseline using 3 non-consecutive web-based self-administered short questionnaires. The food items were based on the Nova classification according to the degree of processing. The Nova score of healthy foods (Nova-HF) is comprised of 33 whole nutrient-dense foods (fruits, vegetables, whole grains, legumes, and nuts), and 23 food items are included in the Nova score of ultra-processed foods (Nova-UPF). Each component of both dietary scores was assigned from 0 to 1 point, where 1 point indicated consumption on the day before. The associations were estimated by multivariable logistic regression models adjusted for possible confounders.

Results: The increment of one standard deviation in the Nova-HF score decreased the odds of excessive BMI gain (OR 0.83; 95%CI 0.83 to 0.93), for Nova-UPF score the odds increased (OR 1.20; 95%CI 1.14; 1.27). Compared to those in the first quintile, the high consumers of Nova-HF (fifth quintile) had lower odds of excessive BMI gain (OR 0.69; 95%CI 0.58; 0.83), while participants in the fifth quintile of Nova-UPF score had higher odds of the outcome (OR 1.66; 95%CI: 1.39; 1.99). For both dietary scores, we observed a linear trend (p<0.001).

Conclusions: The higher consumption of whole nutrient-dense foods may prevent BMI gain, and our findings supported the body of evidence concerning the role of UPF in the obesity epidemic in Brazil. Also, we used simple dietary metrics which are easy to communicate to policymakers.

Keywords: Dietary intake, Obesity, Prevention, Adults, Cohort study

Conflict of Interest Disclosure: No conflicts of interest.

OAB(T6)5-4

Dominant and modifiable factors associated with Abdominal obesity among older adults in West Africa

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Background and objectives: Abdominal obesity (AO) is a public health problem that threatens the wellbeing and quality of life of populations, but information on the burden and factors associated with AO among older adults, particularly among Africans, is quite limited. This study aimed at characterizing dominant and modifiable factors associated with AO among older adults from West Africa.

Methods: We selected 1852 stroke-free older adults (≧60 years) recruited in the Stroke Investigation Research and Educational Network (SIREN) study from fifteen communities in Ghana and Nigeria. In-person interviews were used to obtain information on sociodemographic and lifestyle factors. Waist circumference (WC) in centimetres was measured by trained personnel at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest using a flexible tape rule in a standing position without compression on the skin using the World Health Organization (WHO) guidelines. Abdominal obesity was defined as WC >102 cm (for males) and >88cm (for females) according to the WHO cut-off points. Odds ratio (OR) and 95% confidence interval (CI) of the association of AO with sociodemographic and lifestyle factors were estimated using logistic regression at a two-sided P<0.05.

Results: The mean age was 69.5±7.9 years, 48.9% were females, and 54.7% reside in urban areas. Mean WC was 90.6±15.7cm, and 54.7% were abdominally obese. Prevalence of AO was higher among females (79.9%) than males (30.2%). In the overall population, Females (OR: 13.0; CI: 10.0, 16.9), high-income earners - >$100/month (OR: 1.3; CI: 1.1, 1.7) and those with at least a formal education (OR: 1.5; 95% CI: 1.1,1.9) presented higher odds of AO. A similar trend was observed among males, but current alcohol use (OR: 2.1; CI: 1.1, 3.9) was associated with higher odds of AO among females only. Country-specific analyses revealed higher odds among Ghanaians (females – OR: 19.5; CI: 11.1, 34.2, urban dwellers – OR: 1.9; CI: 1.1, 3.3, high-income earners – OR: 1.7; CI: 1.1, 2.6 and having formal education – OR: 1.7; CI: 1.0, 2.9), but similar odds among Nigerians (females – OR: 11.8; CI: 8.7, 15.9, and having formal education – OR: 1.5; CI: 1.1, 2.0).

Conclusion: The burden of abdominal obesity is high, particularly among females in this sample of older adults from West Africa. Context-specific interventions targeted at these obesity-related factors are likely to be promising in reducing the burden of obesity among older adults in West Africa.

Keywords: Abdominal obesity, Older adults, West Africa, SIREN

OAB(T6)5-5

Beliefs about the consequences of living with obesity: findings from a national survey

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Background and objectives: Adopting healthier lifestyle behaviours can help individuals manage their body weight. Modifying these behaviours can be influenced by beliefs about the consequences of maintaining a healthy weight. Gaining greater understanding of the interpersonal variability in obesity-related beliefs may enhance the design of effective weight management initiatives. This study aimed to capture the beliefs about the outcomes of living with obesity in a nationally representative sample and to explore their relationship with individuals' characteristics and health perceptions.

Methods: A cross-sectional telephone survey was conducted with 1000 adults from the Republic of Ireland and Northern Ireland. Interviews captured: demographics; information on self-rated health and wellbeing; and beliefs regarding the health-, social- and cost-related consequences of obesity (through the Obesity Beliefs Scale). Univariable analysis drew comparisons in obesity beliefs between participants with healthy weight and those with overweight, with obesity and those who did not report their weight. Multiple linear regression tested the association between obesity-related beliefs with demographics, self-perceived health, diet and physical activity, and self-perceived capacity of improving own health behaviours.

Results: Respondents with overweight and those who did not disclose their weight status supported to a lesser extent that living with excess weight has a negative impact on individuals' social life (P < 0.001). Additionally, respondents with obesity and those with no information on weight showed greater endorsement of the cost related to maintaining a healthy weight. The regression model showed that obesity-related beliefs were significantly predicted by weight status (P < 0.001), self-rated health (P = 0.013), dietary quality (P = 0.004) and perceived ease of improving diet (P = 0.001) and physical activity levels (P = 0.001).

Conclusions: The present analysis highlights that adults living with excess weight and those who struggle to improve their dietary habits display a lower endorsement of the negative outcomes of living with obesity. Our findings come in agreement with the limited existing literature and have implications for the design of effective future obesity interventions.

Keywords: Obesity beliefs, weight management, diet and exercise behaviours

Conflict of Interest Disclosure: Authors have no conflict of interest to declare

Further Collaborators: No further collaborators

OAB(T6)5-6

Association between sugar and starch intakes and type 2 diabetes risk in middle-aged adults: the Japan Public Health Center-based Prospective Study

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Background and objectives: Evidence on the relationship between sugar (mono- and disaccharides) and starch intake and type 2 diabetes (T2D) risk in Asian populations is currently insufficient. We aimed to investigate the association between sugar or starch intake and T2D risk in middle-aged Japanese adults.

Methods: Participants comprised 27,797 men and 36,880 women aged 45-75 y with no history of diabetes and critical illness before the survey in 1995-1999 in the Japan Public Health Center-based Prospective Study. We calculated the intake (% energy/d) of sugar (total sugar, total fructose, and each sugar subtype) and starch using a validated 147-item food frequency questionnaire. T2D onset during the five-year follow-up period was defined by self-report, the validity of which was confirmed. ORs and their 95% CIs, adjusted for age, area, family history of diabetes, history of hypertension, occupation, physical activity, smoking and alcohol status, dietary habits, number of birth (for women), and body mass index were estimated using multiple logistic regression with categorical and cubic spline models. The lowest quartile and its median intake were used as reference.

Results: During the follow-up, 690 men and 500 women were identified as new T2D cases. In women, the quartiles of total sugar or total fructose intakes were not significantly associated with T2D risk; however, the spline curves showed an increased T2D risk at extremely high intake levels (ORs [95% CI]: 1.88 [1.07-3.31] at 30% energy/d for total sugar and 1.87 [1.10-3.16] at 14% energy/d for total fructose). Starch intake was positively associated with T2D risk among women in the categorical and spline models (ORs [95% CI] from the spline model: 1.55 [1.13-2.12] at 50% energy/d). In men, sugar and starch intakes were not associated with T2D risk.

Conclusions: In this large-scale population-based cohort study, starch intake was associated with an increased T2D risk in women. For extremely high intake of total sugar or total fructose, a possible increased risk cannot be disregarded in women.

Keywords: Type 2 diabetes, Starch, Sugar, Asian population, Cohort study

OAB(T6)5-7

Nitrites and nitrates from food additives and natural sources and type-2 diabetes risk: results from the NutriNet-Santé cohort

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Background and objectives: Nitrates and nitrites occur naturally in water and soil and are commonly ingested from drinking water and dietary sources. They are also used as food additives in processed meats to increase shelf life and to avoid bacterial growth. The epidemiological literature about the relationship between nitrate and nitrite intakes and the risk of type-2 diabetes (T2D) is very scarce. We aimed to study these associations in a large population based prospective cohort study, distinguishing between natural (food, water) and food additive sources.

Methods: Overall, 104,168 adults from the French NutriNet-Santé cohort study (2009-ongoing, median follow-up time 6.7 years, 78.5% female, mean age [SD]=42.3 [14.5]) were included. Associations between intakes of nitrites and nitrates (evaluated using repeated 24h dietary records, linked to a comprehensive food composition database and accounting for details of commercial names/brands of industrial products) and risk of T2D (ascertained with a multi-source strategy) were assessed using cause-specific multivariable Cox proportional hazard models adjusted for known risk factors (sociodemographic, anthropometric, lifestyle, medical history, and nutritional factors).

Results: During follow-up, 969 incident T2D cases were ascertained. Total nitrites and nitrites from natural sources were both positively associated with higher T2D risk ($HR_{tertile\ 3\ vs.1}$=1.29 (95% CI 1.06-1.56), P_{trend}=0.0043, and 1.27 (95% CI 1.05-1.54), P_{trend}=0.01, respectively). Participants with higher intakes of nitrites from food additives (i.e. above the sex-specific median), and specifically those having higher intakes of sodium nitrite (e250) had a higher T2D risk compared with those who were not exposed to food additive nitrites (HR=1.58 (95% CI 1.28-1.94), P_{trend}<0.001, and 1.59 (95% CI 1.30-1.96), P_{trend}<0.001), respectively). There was no evidence for an association between nitrates of any source and T2D risk (all P_{trend}>0.4).

Conclusions: In this large prospective cohort, higher intakes of dietary nitrites (from both natural sources and food additives) were associated with higher T2D risk. These results need confirmation in other large-scale prospective studies; however, they provide additional evidence in the context of current discussions about updating regulations on the use of nitrites as food additives.

Keywords: nitrites, nitrates, food additives, type-2 diabetes, cohort

Conflict of Interest Disclosure: The authors declare no potential conflicts of interest

Further Collaborators: Fabrice Pierre, Chantal Julia, Stéphane Gigandet, Emmanuelle Kesse-Guyot, Léopold K. Fezeu, Alexandre De Sa, Rebecca Lutchia, Benjamin Allès, Inge Huybrechts, Pilar Galan, Serge Hercberg

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OAB(T6)5-8

Mediterranean diet and physical activity decrease the initiation of medication use for chronic non-cardiovascular diseases in older adults: A cohort study

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Background and objectives: We aim to assess whether long-term adherence to Mediterranean diet (MedDiet) and leisure-time physical activity (LTPA) were linked to less initiation of chronic, non-cardiovascular medications.

Methods: We assessed the relationship between the cumulative average of MedDiet adherence and LTPA and initiation of the 20 most prescribed chronic, non-cardiovascular medication families in older adults (PREvención con DIeta MEDiterránea trial; sample size: 5,940 [anxiolytics]-6,989 [folate supplements]). Associations per each one-point increase in the MedDiet adherence score and 100 metabolic equivalents of task-minute/day (METs-min/day) of LTPA were studied by multivariable Cox regressions (multiple comparisons: False Discovery Rate 5%). We explored non-linear exposure-outcome associations if models using restricted cubic splines fitted the data better than linear terms. We finally evaluated whether MedDiet and LTPA were synergistically linked to lower drug initiation by applying likelihood ratio tests to Cox models with/without the interaction product-term "MedDiet adherence x LTPA".

Results: One-point increases in MedDiet adherence were related to less initiation of: antidepressants (hazard ratio [HR] 0.72, [95% confidence interval 0.67-0.77]), anxiolytics (HR 0.74 [0.69-0.80]), antipsychotics (HR 0.76 [0.64-0.89]), anticonvulsants (HR 0.77 [0.69-0.85]), antiparkinsonian drugs (HR 0.72 [0.59-0.89]), anti-dementia drugs (HR 0.78 [0.67-0.92]), benign prostatic hyperplasia drugs (HR 0.82 [0.75-0.90]), anti-gout drugs (HR 0.80 [0.71-0.89]), hypothyroidism medication (HR 0.77 [0.67-0.89]), laxatives (HR 0.85 [0.75-0.97]), bronchodilators (HR 0.82 [0.74-0.90]), corticosteroids (HR 0.80 [0.73-0.88]), opioids (HR 0.86 [0.77-0.95]), folate supplements (HR 0.69 [0.56-0.85]), iron supplements (HR 0.76 [0.67-0.87]), calcium supplements (HR 0.88 [0.81-0.96]), vitamin D supplements (HR 0.90 [0.83-0.98]), bisphosphonates (HR 0.85 [0.77-0.93]), and cartilage medications (HR 0.86 [0.77-0.95]). LTPA was linearly associated (per +100 METs-min/day) with less initiation of anticonvulsants (HR 0.83 [0.73-0.94]), benign prostatic hyperplasia drugs (HR 0.91 [0.85-0.98]) and bronchodilators (HR 0.80 [0.72-0.89]), and non-linearly linked to less initiation of antidepressants, anxiolytics, anti-dementia drugs, anti-gout drugs, hypothyroidism medication, laxatives, corticosteroids, opioids, iron, calcium and vitamin D supplements, and cartilage medications (minimum risk: 150-400 METs-min/day). Both combined were synergistically related to less initiation of anxiolytics, hypothyroidism medication, iron and calcium supplements (*p*-interaction: 0.037, 0.017, 0.039, and 0.036, respectively).

Conclusions: Sustained adherence to MedDiet and LTPA were linked to lower initiation of non-cardiovascular chronic medications.

Keywords: Mediterranean diet, leisure-time physical activity, chronic medication

Conflict of Interest Disclosure: R.E. reports being a board member of the Research Foundation on Wine and Nutrition, the Beer and Health Foundation, and the European Foundation for Alcohol Research; personal fees from KAO Corporation; lecture fees from Instituto Cervantes, Fundación Dieta Mediterranea, Cerveceros de España, Lilly Laboratories, AstraZeneca, and Sanofi; and grants from Novartis, Amgen, Bicentury, and Grand Fountaine. E.R. reports personal fees, grants, and nonfinancial support from the California Walnut Commission and Alexion; personal fees and nonfinancial support from Danone; and nonfinancial support from the International Nut Council. J.S.-S. reports being a board member and personal fees from Instituto Danone Spain; being a board member and grants from the International Nut and Dried Fruit Foundation; personal fees from Aguas Font Vella Lanjarón, and Danone S.A; and grants from Eroski Distributors. All other authors report no conflicts of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)6-1

Measuring diet-related consumer behaviours in low- and middle-income countries to advance food systems research: An evidence and gap map of indicators

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Background and objectives: Coherent and robust interventions along the food system are essential to deliver healthy diets in a more sustainable manner. The design, monitoring and evaluation of such interventions have been impeded by the lack of validated and commonly used indicators to assess consumer behaviours. This study describes indicators that have been used to measure consumer behaviours regarding the acquisition, preparation, storage, eating and disposal of food in LMICs through an Evidence and Gap Map (EGM).

Methods: A systematic search for articles in English, Spanish, and French published in peer-reviewed journals was conducted in April 2021. Eligible studies were those undertaken in LMICs, published between 2011 - 2021, and included (semi-)quantitative indicators on diet-related consumer practices. Of 5935 articles identified, 260 met inclusion criteria. For data extraction and EGM visualization, EPPI-Reviewer software was used. A descriptive analysis identified the frequency of indicator use across different domains and subdomains of consumer behaviours.

Results: A preliminary analysis of 172 articles identified 765 indicators, including 744 unique, non-repeating indicators. Most were used to measure food acquisition (n=325), followed by preparation (n=134), disposal (n=108), eating (n=101) and storage (n=93). Within the acquisition domain, indicators for types of food acquired (n=160), type of vendor (n=100) and food expenditure (n=60) predominated. Hygiene practices (n=110) and of types of foods prepared (n=64) were most frequently measured within the preparation domain, and location of consumption (n=35) and types of foods eaten (n=26) in the eating domain. Indicators used in the food disposal and storage domains were largely used to measure disposal methods (n=77), use of leftovers (n=49), types of foods stored (n=77), storage methods (n=70), and storage hygiene practices (n=58).

Conclusions: There is a severe lack of concordance on measures for assessing diet-related consumer behaviours outside of food intake. The multiplicity of indicators used in research limits the ability to target and monitor strategies to improve diet behaviours, and to identify the aspects of food systems that contribute to them. Evaluating the validity and uptake of these indicators is a critical next step to support indicator selection for planning, monitoring and evaluating interventions in LMICs.

Keywords: consumer behaviour, indicators, low- and middle-income countries, food systems

Further Collaborators: Renate Wit and Anne Sonneveld, Wageningen University and Research

OAB(T6)6-2

Dietary patterns and brain atrophy in Japanese community-dwellers: the NILS-LSA project

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Background and objectives: Previous empirical evidence has suggested that diet plays a meaningful role in influencing brain atrophy among Western populations. This study evaluates the relationship between dietary habits and brain atrophy in a community-dwelling Japanese population.

Methods: A prospective cohort study with two years of follow-up was conducted as part of the National Institute for Longevity Sciences-Longitudinal Study of Aging (NILS-LSA) project. A total of 1636 participants (815 men and 821 women, aged 40–89 years) were included. Food consumption (g/day) data were collected with a 3-day dietary record. Volumes of gray matter (GM) and white matter (WM) were estimated by T1-weighted brain magnetic resonance imaging and FreeSurfer software. The GM ratio (GMR) and WM ratio were calculated as the percentages of total intracranial volume, respectively. Hierarchical Clustering on Principal Components (HCPC) was performed on dimensions derived by Multiple Factor Analysis (MFA) to obtain dietary patterns (clusters). Associations between dietary patterns and GM and WM atrophy were estimated by multivariable-adjusted General Linear Model. All analyses were performed by sex.

Results: Three different dietary patterns (DP) were identified for men and women, respectively. In women, DP 1 was characteristic of the Western diet (e.g., a high intake of alcohol, red meat and processed meat, coffee, butter, and breads), DP 2 was characterized by a high intake of dairy products, fruits, and coarse grains, and DP 3 represented the traditional Japanese diet. Compared to DP 1, women adherence to DPs 2 and 3 were negatively associated with the annual rate of change of GM volume [(GMR at baseline - GMR at follow-up)/ GMR at baseline/follow-up years×100%] (%) [multivariable-adjusted β (95% CI) = -1.8E-1 (-3.3E-1 to -2.1E-2) and -1.9E-1 (-3.6E-1 to -3.0E-2), *P*-value = 0.026 and 0.020, respectively]. By contrast, no association between dietary patterns and brain atrophy was observed in men.

Conclusions: Western diet was associated with more annual GM atrophy in women. Diet does not appear to be a major risk factor for brain atrophy in men. Perhaps the inhibitory effect of diet on male brain atrophy is offset by the effects of other risk factors.

Keywords: Multiple Factor Analysis, Hierarchical Clustering on Principal Components, dietary pattern, brain atrophy

Conflict of Interest Disclosure: None

Further Collaborators: None

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OAB(T6)6-3

Intakes of major food groups in China and the UK: results from 100,000 adults participating in the China Kadoorie Biobank and the UK Biobank

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Background and objectives: Different populations may exhibit differences in dietary intakes, which may result in differences in diet-disease associations. We compared intakes of major food groups overall, by sex, and by socio-economic status (SES) between participants of the China Kadoorie Biobank (CKB) study and the UK Biobank (UKB) study. We also investigated associations of dietary intake with BMI in each cohort.

Methods: Data were from approximately 25,000 CKB participants who completed a validated interviewer-administered computer-based questionnaire (2013-2014) and around 74,000 UKB participants who completed ≧3 web-based 24-hour dietary assessments (2009-2012). Intakes of 12 major food groups and five beverages were harmonized and compared between the cohorts overall, by sex and by SES (income and education). Multivariable-adjusted linear regression was used to examine the associations between dietary intakes and body mass index (BMI).

Results: CKB participants reported consuming substantially higher quantities of soy products and rice and much lower intakes of milk, yoghurt, other dairy products, all beverages, fresh fruit, poultry, and other staple foods (other than rice and wheat) compared to UKB participants. CKB participants also reported consuming more eggs and fresh vegetables, and less fish and wheat compared to UKB participants. Red meat intake was similar in both cohorts. In both cohorts, intakes of fish, other staple foods, fresh vegetables, fresh fruit and pure fruit/vegetable juice were higher with higher SES. In CKB higher SES was also associated with higher intakes of red meat, poultry, dairy products, and fizzy and other soft drinks, whereas in UKB opposite results were observed. We observed some similarities in the associations of foods and beverages with BMI among the cohorts (e.g. adults who consumed more red meat, poultry, and soft drinks but less milk had a higher BMI), but most of the associations between diet and BMI were dissimilar between the cohorts (e.g. in CKB participants with higher fish consumption had a higher BMI, while the opposite was observed in UKB).

Conclusions: These findings support the hypothesis that possible differences in observed diet-disease associations observed between China and the UK might relate to differences in dietary intakes and their correlates between these populations.

Keywords: China Kadoorie Biobank, UK Biobank, dietary intake, food groups, cohort studies

Conflict of Interest Disclosure: None to declare

Further Collaborators: Pei Pei, Chinese Academy of Medical Sciences

OAB(T6)6-4

Is ultra-processed food and drink consumption associated with environmental impact and all-cause mortality in the EPIC-NL cohort?

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Background and objectives: A body of evidence shows the adverse health effects of high ultra-processed food (UPF) and ultra-processed drink (UPD) consumption. However, the associated environmental impact of UPF and UPD consumption remains unclear. We aimed to assess the association of UPF, UPD or their combined consumption (UFPD) with environmental impacts and all-cause mortality in Dutch adults.

Methods: Habitual diets were assessed in 1993-1997 among 38,261 participants of the EPIC-NL cohort using a validated FFQ. Food consumption was categorized according to the degree of food processing using the NOVA classification and summed in grams per day for each category. Pearson correlation coefficients were used to assess the correlation of consumption according to NOVA in g per 1000 kcal with environmental impact indicators: greenhouse gas emissions, blue water use, land use, acidification and fresh- and marine water eutrophication. Vital status was obtained through linkage with registries. Follow-up lasted to December, 31, 2014. Cox proportional hazard models were used to assess the association of intake of UPFD, UPF and UPD with all-cause mortality.

Results: UPFD, UPF and UPD consumption in g per 1000 kcal were weakly correlated with environmental impact indicators, with correlation coefficients ranging from -0.21 (p = <.0001) for UPF and greenhouse gas emissions, to 0.11 (p = <.0001) for UPD and freshwater eutrophication. With every 100 g per 1000 kcal increase of UPFD or UPD, UPFD and UPD consumption were associated with higher all-cause mortality risks ((HR:1.10 (95%CI:1.06-1.13) and (HR:1.10 95%CI:1.06-1.13), respectively. UPF consumption was not associated with all-cause mortality (HR: 1.05 (95%CI:0.94-1.17).

Conclusions: Higher consumption of UPFD, and UPD only, was associated with an increased all-cause mortality risk, however, not with higher environmental impacts. Therefore,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

diets with lower UPFD consumption may benefit public health. Benefits for planetary health were not observed in a comparison with diets high in UPFD consumption.

Keywords: ultra-processed foods, NOVA classification, all-cause mortality, environmental impact, planetary health

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OAB(T6)6-5

The impacts of partial replacement of red and processed meat with legumes or cereals on the dietary protein and amino acid intake: A modelling study in the Finnish adult population

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Background and objectives: Plant-based diets are considered healthy and environmentally sustainable. However, plant-based diets may reduce protein and amino acid intakes. This modelling study aimed to assess the impacts of partial replacement of red and processed meat with legumes or cereals on the protein and amino acid intakes in the Finnish adult population.

Methods: We used the cross-sectional data of the National FinDiet 2017 Survey in which the diet was assessed by two non-consecutive 24-hour recalls from 875 women and 780 men aged 18-74 years. Mean daily intakes of protein (E%) and indispensable amino acids (mg/kg body weight) were calculated for the current (reference) diet and four replacement scenarios. In the scenarios, the amount of red and processed meat exceeding 70 g/day (Finnish dietary recommendation), or 30 g/day (EAT-Lancet dietary recommendation) was replaced with the same amounts of either legumes or cereals while keeping the consumption of other foods unchanged. Differences to the reference diet were evaluated by gender and age groups (18-64, 65-74 years) based on non-overlapping 95% confidence intervals.

Results: In 18-64-year-old men, the cereal scenario decreased protein intake, the legume scenario decreased methionine+cysteine intake, and both legume and cereal scenarios decreased histidine and lysine intakes at the 70-g replacement level. At the 30-g level, legume and cereal scenarios decreased the intakes of protein and almost all indispensable amino acids. In 65-74-year-old men, the replacement scenarios introduced no differences at the 70-g level. At the 30-g level, the results were similar as in 18-64-year-old men, except that the legume scenario decreased only the intakes of histidine, lysine, and methionine+cysteine. In women, the replacement scenarios introduced no differences in the protein and indispensable amino acid intakes at the 70-g level. At the 30-g level, the cereal scenario decreased protein intake, the legume scenario decreased methionine+cysteine intake, and both scenarios decreased histidine and lysine intakes, but only in 18-64-year-old women.

Conclusions: Partial replacement of red and processed meat with legumes or cereals might slightly decrease the protein and amino acid intake in dependence of gender and age. The amino acid adequacy in the different population groups warrants further study.

Keywords: amino acids, cereals, legumes, protein, red and processed meat

Further Collaborators: The Legumes for sustainable food system and healthy life (Leg4Life) study group. The presented research was funded by the Strategic Research Council at the Academy of Finland (grant numbers 327699, 327698).

OAB(T6)6-6

Qualitative evaluation of a large-scale multi-sectoral nutrition intervention in Nepal: Suaahara's effect on nutrition governance

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Background and objectives: Despite making significant progress over the last two decades in reducing stunting in Nepal, both maternal and child undernutrition in the first 1000-days of life remain major public health burdens. Only few multi-sectoral programs have been implemented at scale, with fewer rigorously evaluated. Suaahara, a USAID-funded initiative since 2011 covers nearly 60% of the country's communities to reduce undernutrition, and along with nutrition-sensitive activities, it supports local, provincial, and national governments to execute Nepal's Multi-sectoral Nutrition Plan (MSNP) for increased allocation and utilization of government funds towards nutrition-specific and nutrition-sensitive interventions. This qualitative study primarily evaluates those interventions' effect at multiple policy levels in improving multisector coordination for MSNP implementation.

Methods: This impact evaluation used a mixed method approach. Fifty-eight relevant nutrition planning and policy documents at all levels were reviewed, and Suaahara monitoring data were analyzed. Semi-structured in-depth interviews, group interviews, and focus group discussions were held with purposively sampled stakeholders including coordinators, representatives, and committee members of key government offices and non-governmental actors. Four intervention districts and four control districts, and two municipalities within each district were selected to represent three geographic zones and five working provinces. Interviews and discussions were

recorded from December 2021 to February 2022 with participants' permission, and transcribed. Qualitative data were analyzed using a deductive and inductive thematic analysis approach. Three authors established inter-rater reliability before coding all transcripts. Nepal Health Research Council granted ethical approval.

Results: Preliminary results suggest Suaahara has helped to improve vertical coordination at policy level to implement and prioritize MSNP activities, driving budget demand. However, limited formal mechanisms to facilitate such coordination, imped fully effective vertical coordination. Budget allocation for and implementation of multisectoral activities in intervention districts were higher than the control districts. Results available in April 2022 will expand upon effectiveness of multilateral coordination, and its effect on improving nutrition governance at each level and effective government budget allocation and utilization.

Conclusions: These will be based on the results to guide future large-scale multi-sectoral programming efforts in Nepal for improving women and child nutrition governance.

Keywords: Evaluation, Nutrition, Health Systems, Governance, Qualitative

Conflict of Interest Disclosure: NA

Further Collaborators: NA

OAB(T6)6-7

Development, validation and item reduction of a food literacy questionnaire (IFLQ-19) with Australian adult

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Background and objectives: Food literacy is theorised to improve diet quality, nutrition behaviours, social connectedness and food security. The definition and conceptualisation by Vidgen & Gallegos, consisting of 11 theoretical components within the four domains of planning and managing, selecting, preparing and eating, is currently the most highly cited framework. However, a valid and reliable questionnaire is needed to comprehensively measure this conceptualisation. Therefore, this study draws on existing item pools to develop a comprehensive food literacy questionnaire using item response theory.

Methods: 500 Australian adults were recruited in Study 1 to refine a food literacy item pool using principal component analysis (PCA) and item response theory (IRT) which involved detail item analysis on targeting, responsiveness, validity and reliability. Another 500 participants were recruited in Study 2 to replicate item analysis on validity and reliability on the refined item pool, and 250 of these participants re-completed the food literacy questionnaire to determine its test-retest reliability.

Results: The PCA saw the 171-item pool reduced to 100-items across 19 statistical components of food literacy. After the thresholds of 26 items were combined, responses to the food literacy questionnaire had ordered thresholds (targeting), acceptable item locations (<-0.01 to +1.53) and appropriateness of the measurement model (n=92% expected responses) (responsiveness), met outfit mean-squares MSQ (0.48 - 1.42) (validity) and had high person, item separation (>0.99) and test-retest (ICC 2,1 0.55-0.88) scores (reliability).

Conclusions: We developed a 100-item food literacy questionnaire, the IFLQ-19 to comprehensively address the Vidgen & Gallegos conceptualisation with good targeting, responsiveness, reliability and validity in a diverse sample of Australian adults.

Keywords: food literacy, survey, item response theory, rasch measurement, validity

Conflict of Interest Disclosure: The authors declare that they have no conflicts of interest.

Further Collaborators: None to report.

OAB(T6)7-1

Nitrites and nitrates from food additives and natural sources and risks of hypertension and cardiovascular disease: results from the NutriNet-Santé cohort

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Background and objectives: Nitrates and nitrites are widely used as food additives, mainly in processed meats. They also occur naturally in water and soil. Some studies suggest a potential beneficial role of dietary nitrites and nitrates in lowering blood pressure. However, to our knowledge, associations between intakes of nitrites and nitrates considering both natural sources and food additives, and risks of hypertension and cardiovascular disease have not been investigated so far. We aimed to study these associations in a large population based prospective cohort study with detailed dietary data.

Methods: Overall, 104,817 adults from the French NutriNet-Santé cohort study (median follow-up time 6.7 years, 78.5% female, mean age[SD]=42.3[14.5]) were included. Intakes of nitrites and nitrates were evaluated using repeated 24h dietary records, linked to a comprehensive food composition database and accounting for details of commercial names/brands of industrial products. Associations with risks of hypertension and

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

cardiovascular disease were assessed using cause-specific multivariable Cox proportional hazard models.

Results: During follow-up, 3810 incident cases of hypertension were ascertained, and 2075 cases of cardiovascular diseases were diagnosed (among which 1004 cerebrovascular diseases and 1079 coronary heart diseases). Participants with higher intakes of nitrites from food additives (i.e. above the sex-specific median), and specifically those having higher intakes of sodium nitrite (e250) had a higher hypertension risk compared with those who were not exposed to food additive nitrites (HR=1.19 (95% CI 1.08-1.31), P_{trend}=0.002, and 1.19 (95% CI 1.07-1.31), P=0.002, P<0.001), respectively). There was no evidence for an association between nitrites or nitrates from natural sources with hypertension risk (all P-values>0.3). There was no evidence for associations between dietary nitrites or nitrates (whatever their source) and risks of cardiovascular, cerebrovascular or coronary heart diseases (all P-values>0.2).

Conclusions: In this large cohort study, higher intakes of nitrites from food additives were associated with higher risk of hypertension. These results do not support any protective association between dietary nitrites or nitrates and cardiovascular outcomes. Though they need to be confirmed in other large-scale prospective studies, these findings provide novel insights in the context of current discussions about updating regulations on the use of nitrites as food additives.

Keywords: nitrites, nitrates, food additives, hypertension, cardiovascular diseases

Conflict of Interest Disclosure: The authors declare no potential conflicts of interest

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OAB(T6)7-2

Carbohydrate and fibre intake, short-chain fatty acid genetic modifiers, and colorectal cancer risk: a prospective analysis in the UK Biobank

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Background and objectives: Wholegrains and fibre intake may decrease the risk of colorectal cancer, although evidence for intake of specific types and sources of carbohydrates and fibre remains unclear. Moreover, cellular and animal studies have shown that short-chain fatty acid (SCFA) production in the gut, which increases with wholegrains and fibre intake, may be associated with lower colorectal cancer risk. However, it is unknown if genetic factors that influence SCFA production may modify the association of carbohydrate quality with colorectal cancer risk. Our objective was to assess the associations of intakes of carbohydrate and fibre sources with risk of colorectal cancer and further explore if associations were modified by a SCFA polygenetic score.

Methods: Using a minimum of 2 (maximum of five) 24-hour dietary assessments, we assessed carbohydrate types and sources and fibre intake in 114,271 UK Biobank participants who were free from cancer at dietary assessments. We used existing data to create a polygenic score to categorise participants as high or low intestinal SCFA producers, namely butyrate and propionate. Multivariable Cox proportional hazards models were used to determine the associations between intakes of carbohydrate types and fibre sources, and colorectal cancer incidence.

Results: During a median follow-up of 8.8 years, 1,129 participants were diagnosed with colorectal cancer. In multivariable adjusted models, intakes of non-free sugar and fibre from wholegrains were inversely associated with colorectal cancer risk (hazard ratio (HR) per 5% energy/day: 0.92, 95% confidence interval (CI):0.87-0.98; HR per 5g/day: 0.90, 0.82-1.00, respectively). There was evidence of heterogeneity by host genetically predicted SCFA production; participants with high genetically predicted propionate production and consuming higher wholegrains and fibre from wholegrains had a lower risk of colorectal cancer (per 5% energy/day:0.89, 0.80-0.99; and per 5g/day:0.84, 0.70-1.00, respectively) whereas no association was observed for participants with low genetically predicted production of propionate (*p-heterogeneity*=0.028 and 0.045, respectively).

Conclusion: This study suggests that colorectal cancer risk varies by intake of different types and sources of carbohydrates; higher consumption of non-free sugars and fibre from wholegrains may lower the risk of colorectal cancer, and these associations may be modified by host genetically predicted SCFA production.

Keywords: Colorectal cancer, Carbohydrates, Fibre, SCFA, Cohort

Conflict of Interest Disclosure: All authors declare no conflicts of interests to disclose.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T6)7-3

Association between adherence to the EAT-Lancet diet and risk of cancer and cardiovascular outcomes in the prospective NutriNet-Santé cohort.

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Background and objective: The EAT-Lancet commission proposed, in 2019, a planetary, healthy and universal dietary. This highly vegetalized diet could prevent approximately 10 million premature deaths per year worldwide while feeding the entire world population within planetary boundaries. However, this diet has been rarely studied in relation to various health outcomes. We aimed to prospectively estimate the association between the EAT-Lancet diet and cancer and cardiovascular risk.

Methods: The study was conducted among participants of the NutriNet-Santé cohort (2009 – 2021). The endpoints were the incident outcomes (cancer and cardiovascular diseases (CVD) and mortality from this diseases), combined and separately. Adherence to the EAT-Lancet diet was estimated using the EAT-Lancet Diet Index (ELD-I) modelled as quintiles (Q). Multivariable Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (95% CIs), adjusted for potential confounders and moderators.

Results: A total of 62,382 subjects were included, 2,475 cases of cancer and 786 cases of cardiovascular occurred during a median follow-up of 8.1 years. The sample was 76% female, the mean age at inclusion was 51 years (Standard Deviation (SD) = 10.2 years). The ELD-I ranged from -162 to 332 points with a mean score of 45.4 points (SD = 25.6 points). In multivariable models, no significant association between the EAT-Lancet diet and the risk of cancer and CVD combined, and separately, was observed. Alcohol consumption was an effect modifier of the association. A significant association was observed among low drinkers (HR $_{Q5\ vs\ Q1}$=0.86, (95% CI 0.73, 1.02), p-trend=0.02). A higher ELD-I was significantly associated with a lower risk of overall cancer only among females, (HR $_{Q5\ vs\ Q1}$=0.89, (95% CI 0.75, 1.05), p-trend=0.03). Both associations were largely attenuated by body mass index.

Conclusion: Contrary to our hypothesis, our results documented significant associations between adherence to the EAT-Lancet diet and incidence of overall chronic diseases and cancer only in some subgroups (females and low drinkers), and no association with CVD. Some important dietary factors, such as processed meat or excessive energy intake, not considered in the EAT-Lancet diet, should be considered in the future.

Keywords: Nutrition, Sustainable diet, Healthy eating, Food system, Chronic diseases

OAB(T6)7-4

Dietary exposure to acrylamide and breast cancer risk: results from the NutriNet-Santé cohort

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Background and objectives: Acrylamide is found in many industrial compounds, in tobacco smoking and, also, is formed when carbohydrate-rich foods and coffee are prepared at high temperatures and low moisture. Acrylamide has been classified as a probable human carcinogen in 1994 but epidemiological evidence on the detrimental effect of dietary acrylamide is limited. This prospective cohort study aimed to investigate the associations between dietary acrylamide and the risk of breast cancer, accounting for menopausal and hormone receptors status, in the large NutriNet-Santé prospective cohort with detailed dietary data.

Methods: Overall, 80,597 women from the French NutriNet-Santé cohort study (2009-ongoing) were included (mean [SD] age at baseline: 40.8 [14] years), and followed during 8.8 (SD 2.3) years. Acrylamide intake was evaluated using repeated 24h dietary records, linked to a comprehensive food composition database. Associations between acrylamide intake and breast cancer risk (overall, premenopausal and post-menopausal) were assessed by Cox hazard models adjusted for known risk factors.

Results: The mean (SD) dietary acrylamide intake was 30.1 (21.9) µg/d (main contributors: coffee, potato fries and chips, pastries and cakes, and bread). During follow-up, 1016 first incident breast cancer cases were diagnosed (431 premenopausal, 585 postmenopausal), of which 86% were characterized as estrogen-receptor positive (ER^+). A borderline significant positive association was observed between dietary acrylamide exposure and breast cancer risk overall (HR $_{Q4\ vs\ Q1}$= 1.21 [95% CI: 1.00-1.47]) and a positive association was observed with premenopausal cancer (HR $_{Q4\ vs\ Q1}$= 1.40 [95% CI: 1.04-1.88]). Interestingly, restricted cubic spline analyses suggested evidence for non-linearity of these associations, with higher HR for intermediate (Q2) and high (Q4) exposures. Receptor-specific analyses revealed a positive association between dietary acrylamide and ER^+ breast cancer overall (HR$_{Q4\ vs\ Q1}$= 1.31 [95% CI: 1.01-1.71]) and in premenopausal women (HR $_{Q4\ vs\ Q1}$= 1.66 [95% CI: 1.07-2.56]). Acrylamide intake was not associated with post-menopausal breast cancer.

Conclusions: Results from this large prospective cohort study suggest the potential role of dietary acrylamide in breast

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

cancer etiology, especially in premenopausal women. These data provide new insights that should encourage further mitigation strategies to reduce the content of acrylamide in industrial and home-made foods.

Keywords: Acrylamide, Neo-formed contaminant, Food processing, Breast cancer risk, Cohort

Conflict of Interest Disclosure: The authors declare no conflicts of interest

Further Collaborators: Françoise Guéraud, Laurent Zelek, Laury Sellem, Chantal Julia, Pilar Galan, Serge Hercberg

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OAB(T6)7-5

Food additive emulsifiers and cancer risk: results from the French prospective NutriNet-Santé cohort.

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Background and objectives: Food additive emulsifiers are widely used in ultra-processed foods (UPF) to improve texture and lengthen shelf-life. Experimental studies suggested potential detrimental effects of emulsifiers on gut microbiota and inflammation, and carcinogenesis initiation and/or progression. However, to our knowledge, no epidemiological study investigated the associations between food additive emulsifier intakes and overall or location-specific cancer risks. Thus, this study aimed to investigate these associations in a large population-based prospective cohort study with detailed quantitative data on emulsifier exposure.

Methods: This study included 102,485 French adults without prevalent cancer from the NutriNet-Santé prospective cohort study (mean age [SD] 42.1y [14.5], 78.8% female, 2009-2021). Food additive emulsifier intakes were estimated using repeated 24-h dietary records linked to comprehensive, brand-specific food composition databases on food additives. Multi-adjusted proportional hazard Cox models were used to characterise associations with overall, breast, prostate, and colorectal cancer risks.

Results: 3,511 incident cancer cases were diagnosed during follow-up (including 1,026 breast, 431 prostate, and 279 colorectal cancers). Intakes of sodium citrate (E331, HR=1.12, 95%CI=1.02-1.23, p-trend=0.009), xanthan gum (E415, $HR_{high\ vs.\ low}$=1.11, 95%CI=1.02-1.21, p-trend=0.02), and mono- and diglycerides of fatty acids (E471, HR=1.17, 95%CI=1.06-1.28, p-trend=0.001 and total: E471, E472, E472a-b-c-e, HR=1.11, 95%CI=1.02-1.22, p-trend=0.02) were associated with increased overall cancer risk. In addition, higher intakes of E331 (p-trend=0.046), sodium stearoyl-2-lactylate (E481, p-trend=0.01), and total lactylates (E481-482, p-trend=0.01) were associated with increased overall breast cancer risk. Higher intakes of carrageenan (E407, p-trend=0.04), E415 (p-trend=0.02), and triphosphates (E451, p-trend=0.03) were associated with increased post-menopausal breast cancer risk. Moreover, both overall and post-menopausal breast cancer risks were directly associated with higher intakes of total celluloses (E460-468, p-trend=0.03 and 0.03, respectively), carob bean gum (E410, p-trend=0.01 and 0.001), E471 (p-trend=0.006 and 0.03).

Conclusions: In this large prospective cohort study, we observed direct associations between cancer risks and exposures to seven individual and three groups of dietary emulsifiers, which are commonly used in thousands of brands of UPF worldwide. These results provide the first epidemiological insights into the role of food additive emulsifiers on cancer risk, and need to be confirmed in further epidemiological and experimental research.

Keywords: dietary emulsifiers, food additives, cancer risk, prospective cohort

Conflict of Interest Disclosure: The authors declare no potential conflicts of interest.

Further Collaborators: Nathalie Druesne-Pecollo, Younes Esseddik, Fabien Szabo de Edelenyi, Cédric Agaësse, Emilie Viennois, Alexandre De Sa, Rebecca Lutchia, Augustin Scalbert, Chantal Julia, Emmanuelle Kesse-Guyot, Benjamin Allès, Pilar Galan, Serge Hercberg.

OAB(T6)7-6

Estimated impact of modest dietary salt reduction on the burden of stomach cancer and population healthy life years in Vietnam, 2019 – 2030

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Background and objectives: Excess salt intake is a recognized risk factor for stomach cancer. However, the longterm impact of high salt intake on stomach cancer in Vietnam is not known. The aim of this study was to quantify the future burden of stomach cancer that could be avoided from population-wide salt reduction in Vietnam.

Methods: A dynamic epidemiological multistate lifetable model was developed to quantify the impacts of achieving the 2018 Vietnam National Health Program (8g/day by 2025 and 7g/day by 2030) and the WHO (5g/day) salt reduction targets. All

adults aged 25 years and above (total of 61 million people, 48.4% men) alive in 2019 were simulated over their remaining lifetime. Data on salt consumption were obtained from the Vietnam 2015 WHO STEPS survey and baseline stomach cancer data were from the Global Burden of Disease 2019 study. Health outcomes were estimated over 6-year (by 2025), 11-year (by 2030) and lifetime horizons. We conducted one-way and probabilistic sensitivity analyses.

Results: Achieving the 2025 and 2030 national salt targets could result in 3,500 (95% uncertainty interval [UI]: 1,590; 5,840) and 7,700 (95%UI: 3,880; 12,685) fewer incident cases of stomach cancer respectively and avert 1,950 (95% UI: 810; 3,410) and 5,200 (95%UI: 2,430; 8,855) stomach cancer deaths, respectively. Achieving the WHO target by 2030 could prevent 9,280 (95%UI: 5,430; 13,960) new cases of, and 6,300 (95%UI: 3,510; 9,741) deaths from stomach cancer. Over the lifespan, this translated to 359,000 (8g/day), 416,000 (7g/day) and 505,000 (5g/day) health-adjusted life years gained respectively. Compared to base case theoretical minimum risk exposure level (TMREL) of 3g of sodium, health outcomes increased by up to 35% and could reduce by 65% for TMRELs of 1g and 5g of sodium, respectively.

Conclusions: A substantial burden of stomach cancer could be avoided, with gains in healthy life years if national and WHO salt targets were attained. Our findings provide impetus for policy makers in Vietnam to intensify salt reduction strategies to combat stomach cancer.

Keywords: Sodium, gastric cancer, incidence, mortality, burden of disease

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OAB(T6)8-1

Nudge-Based Interventions in Promoting Healthy Eating Behavior in Brick-and-Mortar Stores

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Background and objectives: Developing effortless and sustainable healthy eating behavior is a public health challenge. This study examined the effect of nudge-based interventions, using fast thinking (point-of-purchase advertising) and slow thinking (remembering target products), on consumers' eating behavior in stores.

Methods: Advertisements to promote the appeal of nutritious products were placed in a store in Tokyo, and a month-long intervention was conducted regarding the customers' impressions of the advertisements and their attributes after purchasing the products. Based on the difference-in-differences design, we compared the nudged products with products that had the same sales slope over the last three months to exclude the effect of trend. We calculated the monthly ratio of the sales of target products to estimate the period of the intervention effect.We also examined the background details (age, sex, income, education, marital status, and medical history) of the customers who received the interventions in our analysis from January 2019 to February 2022. (Total number of customers: 41,000)

Results: Sales increased by 68% despite the bad weather and the insufficient replenishment of products. The effects of health advertising and remembering target products-based interventions were maintained for up to eight months before external factors. Additionally, the effect of the interventions may differ based on the background of the customer.

Conclusions: The significant increase in sales could not be attributed to advertising alone it is possible that remembering target products, which requires slow thinking, helped retain the products in the consumers' memory, making the advertisement self-serving and promoted continuous purchases. Furthermore, it is necessary to consider the customers' background for effective intervention.

Keywords: Nudge, Indifferent Health, Eating Behavior, Intervention, Causal Inference

Conflict of Interest Disclosure: The presenters have no conflict of interest with the corporate organizations relating to this presentation.

OAB(T6)8-2

Socio-economic and Agricultural related Factors Associated with Stunting of Under Five-year Children: Findings from Panel Surveys in Mountains, Dry Zone and Delta Regions of Rural Myanmar (2016-17)

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Background and objectives: The first Myanmar DHS survey (2015-2016) showed the prevalence of stunting among under-five children was 29.2%. Nonetheless, there is limited information about the factors contributing to stunting in these children. Our objective was to investigate food security, dietary diversity, agriculture, and socio-demographic status of rural households in three agro-ecological zones in Myanmar and the association with under-five child stunting.

Methods: We conducted two repeated cross-sectional surveys among the same rural households in mountainous, central dry and delta areas of Myanmar in early 2016 and revisited in late 2017 to capture seasonal variations. We

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

purposely selected two adjacent townships in each location, randomly selected 20 villages from each township using proportion to population size sampling, and selected 30 households in each village, giving 1200 households with under 5-year children per region. In each survey, we collected data digitally using CommCare, including household characteristics, land access, agricultural access, women's autonomy, dietary diversity, food security and anthropometry data. We constructed village-level scores for agricultural diversity and transportation. We applied univariate and multilevel mixed-effects Poisson regression analysis to identify the risk factors for child stunting.

Results: We recruited 3,231 households and assessed 2049 under-five children in the first-round survey in early 2016. In the second survey in late 2017, we revisited 90.4% of the same households (N=2,921 and assessed 1696 under-five children. Stunting increased from 40.4 % to 42.0 %. The percentage of food secure households and women achieving minimum dietary diversity increased in the second survey. The adjusted Poisson models showed a consistent association of children's age and short maternal stature with child stunting. In Chin, significant contributors to stunting were village-level transportation, crop consumption, and agriculture diversity scores. While in Magway, it was wealth status, land ownership, the number of household members and in Ayeyarwady, women's autonomy and indicators related to hygiene and sanitation.

Conclusions: Children in rural Myanmar are vulnerable to undernutrition. While area-specific factors were associated with stunting, maternal short stature and child age were consistent determinants of stunting across the three regions assessed. Addressing intergenerational malnutrition requires a multi-sectoral local approach, including transportation improvements.

Keywords: food security, stunting, rural Myanmar, Under Five-year Children

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OAB(T6)8-3

Sustainable Diets Across Socio-Demographic Groups of the Finnish Populations – the case Just-Food

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Background and objectives: Dietary changes form a central pillar of the necessary sustainability transformation of food systems. However, identifying sustainable diets is difficult because of the near-infinite number of food combinations, the possibility of trade-offs among sustainability dimensions and the need for diets to remain socio-culturally acceptable. The research aims at characterizing healthy diets as similar to existing diets as possible but with a reduced climate footprint, considering different socio-demographic groups of the Finnish adult population.

Methods: A diet optimization model minimizes departure from the average diet of a group subject to detailed nutritional constraints, palatability constraints and a maximum level of greenhouse gas emissions (GHGE). The model is calibrated to different socio-demographic groups based on gender, education and income. Three scenarios are simulated by varying the maximum permissible carbon footprint of the diet (1- no restriction; 2- 33% reduction from observed level; 3- 50% reduction). The calibration relies on Finnish dietary intake data (FinDiet2017), the food composition database Fineli, and Life Cycle Assessment (LCA) coefficients. A sensitivity analysis investigates the robustness of the results.

Results: Across all socio-demographic groups, there are large synergies between improvements in nutritional quality of the diets and reductions in climate impact. The primary mechanism for reducing GHGE is the substitution of cereals and potatoes for meat. The secondary mechanism is the intra-category substitution of foods, such as poultry for beef. The simulated climate-friendly diets are best described as flexitarian. Moving towards climate-friendly diets would not create major nutritional problems related to protein and fatty acid quality but iron could be an issue for pre-menopausal women. We find that the initial socio-economic gradient in the climate impact of diets is small and that there are only minor differences in patterns of adjustments to climate-friendly diets across socio-demographic groups. The results are robust to the replacement of LCA coefficients by environmental coefficients derived from the Input-Output model ENVIMAT.

Conclusions: A one third reduction in the climate impact of diets is achievable through moderate adjustments in dietary behaviours. The required adjustments are similar across socio-demographic groups, so that a population-wide policy to promote behavioural change would be appropriate.

Keywords: diet, optimization, sustainability, climate change, environmental impact

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OAB(T6)8-4

Estimating the Costs of Alternative Large-Scale Food Fortification Programs in Burkina Faso: A MINIMOD Tool for Informing Policy Discussion

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Background and objectives: Decisions regarding the types and amounts of micronutrients to include in large-scale food fortification (LSFF) programs should consider costs. The Micronutrient Intervention Modeling (MINIMOD) cost tool estimates the costs of alternative LSFF programs, with focus on the cost burdens to different stakeholders.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: An existing activity-based cost model was adapted to the context of Burkina Faso. Key national characteristics (e.g., population size), and information on existing and hypothetical LSFF programs (e.g., adherence to standards) establish the model's platform. Private- and public-sector costs (as relevant) of designing, implementing, and managing LSFF are included. The model contains a micronutrient premix cost calculator that allows users to examine the costs of alternative premixes. LSFF-vehicle-specific consumption patterns (e.g., g/day of fortifiable wheat flour consumed, based on household survey data) link program costs to program reach. A ten-year planning time horizon is adopted.

Results: The premix required to fortify wheat flour with iron and folic acid (60 mg/kg of ferrous fumarate, 2.5 mg/kg of folic acid – the current standard) is estimated to cost ~$2.11 (2020 USD) per MT of fortified flour, with overall 10-year program costs of ~$2.4m; ~25% faced by industry (e.g., internal quality control), ~23% by government (e.g., external monitoring), and 52% by stakeholders who would cover premix costs (generally assumed to be industry, with some pass-through to consumers). Cost per person and cost per person reached are ~$0.010 and ~$0.023, respectively. Including zinc in this premix (95 mg/kg of zinc oxide) would increase the cost per MT of fortified flour to ~$3.02, total 10-year program costs to ~$3.3m, and cost per person and per person reached to ~$0.014 and ~$0.032, respectively. The premix's share of costs increased to ~54%.

Conclusions: The levels and compositions of the costs should be considered when designing and managing LSFF, in part because different stakeholder groups, including consumers, will be called upon to pay them. Premix costs are one main cost driver; increasing the number and/or amounts of fortificants will increase overall program costs and shift the burden of costs among stakeholders, perhaps putting upward pressure on the price of a baguette in Ouagadougou (currently 150 XOF, or USD 0.25).

Keywords: Food fortification, micronutrients, costs, cost-effectiveness, Burkina Faso

Conflict of Interest Disclosure: No conflicts of interest.

Further Collaborators: None.

OAB(T6)8-5

Evaluating 10 years of large-scale multi-sectoral nutrition interventions in Nepal: Suaahara's effect on undernutrition, household behaviors and the health system

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Background and objectives: Despite significant progress over the last two decades of reducing stunting in Nepal, both maternal and child undernutrition remain major public health burdens. Both health and non-health interventions are important for reducing malnutrition, but few multi-sectoral programs have been implemented at scale and even fewer rigorously evaluated. Suaahara, a USAID-funded initiative since 2011, gradually scaled up to cover nearly 60% of the communities in the country with an aim to reduce undernutrition among mothers and children in the first 1000-days of life. Suaahara works on nutrition, health, family planning, agriculture, governance, and gender and social equality. Many of the interventions target social and behavior change, but Suaahara also has other interventions such as health system strengthening and support to the government at local and national levels to implement Nepal's Multi-sectoral Nutrition Plan. The primary objective of this study is to evaluate the effect of the multiple interventions within this program on reducing maternal and child undernutrition; improving household health, nutrition, and WASH behaviors; and improving knowledge and skills among health workers.

Methods: This impact evaluation uses a quasi-experimental, repeated cross-sectional design. The multi-stage clustering, as of the endline, includes: first, districts (8: 4 program and 4 control); second, Village Development Committees (VDC) (5 per district); third, wards (3 wards per VDC), and fourth, households with children under 2 years of age (17 per ward). The first three stages use the probability-proportional-to-size method and households are selected via simple random sampling. The baseline data collection was done in June-September 2012 and the endline data collection is planned for June-September 2022. Data collection is done by an externally hired survey firm overseen by an external principal investigator and research team. Ethics approval has been granted by the Nepal Health Research Council.

Results: Results will be available in the fall including primary impact estimates for child stunting, wasting, underweight, and anemia; maternal underweight and anemia; and maternal and child dietary diversity. From the health systems evaluation, key indicators will include knowledge and skills related to maternal and child nutrition and health among both Female Community Health Volunteers and health facility workers.

Conclusions: The results will be used to guide future large-scale multi-sectoral programming efforts in Nepal and similar contexts.

Keywords: Evaluation, Nepal, Health Systems, Behavior Change, Maternal and Child Nutrition

Conflict of Interest Disclosure: NA

Further Collaborators: Evaluation Advisory Committee
New Era, Nepali survey firm conducting field work for evaluation

OAB(T6)8-6

Less meat in the shopping basket: a randomised controlled trial in a virtual supermarket

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Background and objectives: Reduced meat consumption benefits human and planetary health. Significant health and environmental gains that could be achieved through fiscal measures targeting meat and combinations of food policy instruments. The aim of the study is to examine the effect of higher meat prices, an information nudge and a combination of both measures on meat purchases in a three-dimensional virtual supermarket.

Methods: A parallel designed randomised controlled trial with four conditions was performed. Participants (older than 18 years) were randomly assigned to the control condition or one of the experimental conditions: a 30% price increase for meat ('Price condition'), an information nudge about the environmental impact of meat production and consumers' role in that regard ('Information nudge condition') or a combination of both ('Combination condition'). Participants were asked to shop for their household for one week. The primary outcome was the difference in the total amount of meat purchased in grams per household per week.

Results: Between 22 June 2020 and 28 August 2020, participants were recruited and randomly assigned to the control and experimental conditions. The final sample included 533 participants. In the 'Combination condition', -386 g (95% CI: -579, -193) meat was purchased compared with the 'Control condition'. Compared to the 'Control condition' less meat was purchased in the 'Price condition' (-144 g (95%CI: -331, 43)), although not statistically significant, whereas a similar amount of meat was purchased in the 'Information nudge condition' (1 g (95%CI: -188, 189)).

Conclusion: Achieving the most pronounced effects on reduced meat purchases will require a policy mixture of pricing and informational nudging. Less meat is purchased in a virtual supermarket after raising the meat price by 30% combined with an information nudge. The results can be used to design evidence-based policy measures to reduce meat purchases.

Keywords: randomised controlled trial, meat, information nudge, fiscal measure, food policy instruments

Conflict of Interest Disclosure: None

Further Collaborator: Marcello van Teijlingen contributed to the development of the conditions

OAB(T6)8-7

Estimated health benefits, costs, and cost-effectiveness of eliminating industrial trans-fatty acids in Kenya

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Background and objectives: There is an urgent need to eliminate industrial trans fatty acids (iTFA) from the food supply globally to reduce the burden of ischemic heart disease (IHD). Many countries in Africa have not yet implemented policies targeting the elimination of TFA. The objective of the current study was to model the potential health gains and cost-effectiveness of a mandatory limit of iTFA in Kenyan foods.

Methods: Markov cohort models were used to estimate the effect on IHD burden and cost-effectiveness of a mandatory iTFA-limit (≦2% of all fats) in the Kenyan food supply. Intake of trans-fatty acids was assessed using the 2019 Global Burden of Disease Study. The IHD burden attributable to iTFA was calculated by comparing the current level of iTFA intake to counterfactual settings with complete elimination of iTFA intake. Policy implementation costs (including government spending for legislation and monitoring, and industry spending for product reformulation), avoided IHD events and deaths, health-adjusted life years (HALYs) gained, and healthcare costs saved were estimated over 10 years and lifetime of the Kenyan population. Cost-effectiveness was assessed by calculation of incremental cost-effectiveness ratios (ICER) using net policy cost and HALYs gained (both with 3% discount rate).

Results: Over the first 10 years, complete elimination of iTFA intake was estimated to prevent 1,622 (95% uncertainty interval [UI]: 1,495; 1,752) IHD deaths and 14,852 (95% UI: 13,664; 16,061) IHD events, and to save 98 million USD (95% UI: 90; 106). The corresponding estimates over the population lifetime were 39,812 (95% UI: 36,420; 43,262), 94,362 (95% UI: 86,080; 102,831), and 437 (401; 475). Policy implementation costs (government plus industry) were estimated to ~7.4 million USD over the first 10 years, and ~8.3 million USD over the population lifetime. The intervention was estimated to be cost-saving regardless of the time horizon and findings were robust across several sensitivity analyses.

Conclusions: Findings support legislating a mandatory limit of iTFAs as a cost-saving strategy to avert substantial numbers of IHD events and deaths in Kenya.

Keywords: Policy, Trans fat, Kenya, Cost-effectiveness, Ischemic heart disease

OAB(T6)8-8

Acute effects of running on ghrelin concentrations, subjective appetite and energy intake in physically active and inactive young men

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Background and objectives: It has been suggested that habitual physical activity influences homeostatic appetite control by increasing the drive to eat through greater energy expenditure. The limited available evidence also showed that physically active individuals compensated for the energy deficits induced by exercise quicker (i.e., energy intake) than physically inactive individuals. However, the acute effects of exercise on acylated ghrelin (an active form of ghrelin and is the only known appetite-stimulating hormone) and des-acylated ghrelin (an inactive but major form of ghrelin) in humans with different physical activity statuses remain unclear. Thus, the present study aimed to compare acylated-ghrelin, des-acylated ghrelin, subjective appetite and energy intake between physically active and inactive men in response to a single bout of exercise.

Methods: Thirty-three, healthy active (n = 15, aged 23 ± 2, mean ± standard deviation) and inactive (n = 18, aged 22 ± 2) men underwent a 2-h laboratory-based experiment. The objective measurement of physical activity using accelerometers was used to allocate participants to the active and inactive groups. All participants performed a 30-min running at 70% of maximum oxygen uptake (0930-1000 h) and then rested until 1130 h. Blood samples and subjective appetite were collected in the fasted state (0930 h), at 1000, 1015 (subjective appetite only), 1030, 1100 and 1130 h. Then, all participants were asked to record their food and beverage intake for the remaining day.

Results: There were no differences in fasting, or the patterns of the plasma concentrations of acylated ghrelin, des-acylated ghrelin or subjective appetite between groups (all for $p > 0.05$). Both total energy intake (active versus inactive groups, 8679 ± 2668 and 7305 ± 3217 kJ, respectively) and relative energy intake (postexercise energy intake corrected for the energy cost of exercise: active versus inactive groups, 7256 ± 2668 and 5976 ± 3171 kJ, respectively) were similar between groups (all for $p > 0.05$).

Conclusions: These findings imply that inactive but otherwise healthy young men may have similar homeostatic appetite control to those of healthy active young men in response to acute energy deficits induced by running.

Keywords: appetite-related hormone, subjective appetite, energy intake, physical activity status

OAB(T7)1-1

Influence of the particle size of encapsulated chia oil on the bioaccessibility during in vitro gastrointestinal digestion

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Background and objectives: Among vegetable oils, chia oil has been gaining interest in recent years due to its high linolenic acid content (ALA, 18: 3 w3). The aim of this work was to study the influence of particle size of encapsulated purified chia oil (PCO) on encapsulation efficiency and PCO release during in vitro digestion.

Methods: PCO micro- and nano-sized particles with sodium alginate (SA) as an encapsulating agent (ME-PCO-SA and NE-PCO-SA) were designed by micro and nano spray-drying, respectively, applying a central composite plus star point design.

Results: NE-PCO-SA showed smaller particle size and higher encapsulation efficiency of PCO than ME-PCO-SA (0.16 mm vs. 3.5 mm; 98.1% vs. 92.0%). Emulsions (NE-PCO, ME-PCO) and particles (NE-PCO-SA and ME-PCO-SA) were subjected to in vitro gastrointestinal digestion. ME-PCO and NE-PCO showed sustained oil release throughout the three phases of digestion (oral, gastric and intestinal phases), whereas the PCO released from ME-PCO-SA and NE-PCO-SA occurred mainly in the intestinal phase, showing the suitability of SA as intestine-site release polymer. Nano-sized particles showed significantly higher bioaccessibility of individual FFA, such as C18:3 w-3 (NE-PCO-SA, 23.6%; ME-PCO-SA, 7.9%), due to their greater surface area.

Conclusions: Therefore, SA spray-dried micro and nanoparticles showed great potential for vehiculation of omega-3 rich oils in the design of functional foods allowing the preservation of their nutritional properties in the intestine-site release.

Keywords: bioaccesibility, digestion, spray-dryer, nanoparticles, microparticles

Conflict of Interest Disclosure: There are no conflicts to declare

Further Collaborators: This research was funded by ANID (Fondecyt Project 1181329 and CONICYT/ANID National Doctoral Scholarship), Chile.

OAB(T7)1-2

Association between coffee consumption and metabolic syndrome: a cross-sectional and Mendelian randomization study from UK Biobank

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Background and objective: Current literature regarding the effect of coffee consumption on metabolic health remains inconsistent. This study aimed to investigate the associations between coffee consumption and metabolic syndrome and its component conditions: high fasting glucose, high triglycerides, central obesity, high blood pressure, and low high-density-lipoprotein cholesterol in adults. The effects of using milk, sugar, and artificial sweetener on these associations were also investigated.

Methods: The cross-sectional analysis included 351,793 white British participants (18 years of age or older) of the UK Biobank. Coffee consumption was measured using food frequency questionnaires and 24-hour recalls and metabolic syndrome was ascertained based on blood biochemistry results and self-reported medication use. Odds ratios were obtained using multivariable logistic regression adjusting for lifestyle and socioeconomic factors. The presence of causal association was assessed using two-sample Mendelian randomization, with the data of the association between single nucleotide polymorphisms and coffee consumption extracted from the Coffee and Caffeine Genetics Consortium and those of metabolic health outcomes from the UK Biobank.

Results: Coffee consumption up to 3 cups per day was inversely associated with metabolic syndrome (1 cup/day, OR: 0.88, 95% CI: 0.85, 0.92; 2 cups/day, OR: 0.90, 95% CI: 0.86, 0.93; 3 cups/day, OR: 0.94, 95% CI: 0.90, 0.99) while associations at higher intakes were near null. Mendelian randomization did not support a causal association between coffee intake and metabolic syndrome. Both self-reported and genetically predicted high coffee consumption (4 cups per day or more) were associated with central obesity. The inverse association between coffee consumption and metabolic syndrome was more profound among ground coffee drinkers than instant coffee drinkers. Results were similar when stratified by the use of milk and sugar, yet the use of artificial sweeteners with coffee was positively associated with metabolic syndrome and all component conditions.

Conclusions: Coffee consumption likely increased risks of central obesity but unlikely impacted the risk of metabolic syndrome. The possible health effect of using artificial sweeteners with coffee warrants further investigations.

Keywords: coffee, metabolic syndrome, Mendelian randomization, artificial sweetener, sugar

OAB(T7)1-3

Metabolomic assay, *in vitro* and *in vivo* studies of anti-obese and lipid profile improving activity of kombucha drink from *Caulerpa racemosa* as potential functional beverage

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Background and objectives: Obesity is currently a global issue and is a major cause of the metabolic disorder. However, currently approved treatments have various limitations including serious side effects, numerous contraindications, and lack of acceptance. *Caulerpa racemosa*, also referred as Sea grapes, is a seaweed known for its various benefits. In order to maximize its health benefits, *C. racemosa* was made using kombucha drink as a carrier medium. This study aims to explore the metabolites profile and assess the effect of Sea grapes kombucha drink on lipase activity *in vitro* and lipid profile *in vivo*.

Methods: Metabolomic profiling was done in the Central Hayati Laboratory Brawijaya University using LC-HRMS and Compound Discoverer with mzCloud MS/MS Library Processing data software to identify three major compounds. A lipase inhibition test was carried out by incubating Sea grapes kombucha drink compared with orlistat as the control in porcine pancreatic lipase and p-nitrophenyl butyrate in reaction buffer. A total of four groups were made, each containing 10 male swiss webster albino mice; group A received standard dry pellet diet as control, group B received cholesterol and fat-enriched diets (CFED), group C and D received CFED and 150 and 300 mg/kgBW of kombucha drink from Sea grapes respectively for 4 weeks. Research protocol No.100/EC/KEPK-KANDOU/VI/2021 (RSUP Prof. Dr. RD. Kandou, Manado), and No. PCTE0000258 (preclinicaltrials.eu Europe).

Results: *Betaine*, 2*,2,6,6-Tetramethyl-1-piperidinol* (TEMPO), *Hexadecanamide* is the major compounds that has been identified and suspected to contribute anti-obesity and lipid profile improving on in *vivo study*. Sea grapes kombucha drink improved lipid profiles in the way of reducing total cholesterol, triglyceride, LDL, and increasing HDL levels compared to CFED and normal groups. The effect was more robust following the incrementing dose of the Sea grapes excluding total cholesterol. The lipase inhibitory activity of Sea grapes kombucha drink was similar to orlistat at a dose of 250 µg/mL, otherwise, orlistat was superior in the lower doses. Sea grapes kombucha drink treatment also induced weight loss and increased level of liver SOD.

Conclusions: Kombucha drink from *C. racemosa* has good potential as a functional beverage with anti-obese and lipid improving activity.

Keywords: Caulerpa racemosa, dyslipidemia, kombucha, obesity, nutraceuticals

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)1-4

β-Lactolin, a novel whey-derived peptide, improves mood states and enteric microbiome metabolites: A randomized placebo-controlled trial.

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Background and objectives: In our rapidly aging society and ever-changing social environment, depression and mood disorders have become an important social issue. Preventive approaches have received increased attention. Previous epidemiological studies suggested that intake of fermented dairy products helps reduce the risk of depression and mood disorders. We have previously discovered the novel whey-derived peptide β-lactolin (Gly-Thr-Trp-Tyr tetrapeptide) in fermented dairy products. Orally administered β-lactolin increases dopamine in the frontal cortex via monoamine oxidase B inhibition. β-lactolin has been found to improve depression-like behavior in mice. β-lactolin also improves intestinal microbiome metabolites and anxiety in mice. However, the effects of β-lactolin on human mood states have not yet been investigated. The current study investigated the effects of β-lactolin on mood states of healthy adults with poor mental health in a randomized placebo-controlled trial.

Methods: Sixty healthy adults aged 45~64 years old with poor mental health without diagnosed depression were selected using screening questionnaires (BDI-II and GHQ28). Participants were randomly allocated into the β-lactolin group (tablets containing 1.6 mg β-lactolin once per day) or placebo group. After six weeks, participants completed psychiatric questionnaires (State-Trait Anxiety Inventory (STAI), Perceived Stress Scale, Apathy Scale, and 36-item Short Form Survey (SF-36)) to report mood states and quality of life Participants also provided saliva and feces samples at the baseline and after the intervention for the analysis of IgA and SCFAs, respectively.

Results: The β-lactolin group showed a significant improvement in anxiety (p=0.046), perceived stress (p=0.043), mental health scores (p=0.039), salivary IgA levels (p=0.045), and SCFAs levels compared to the placebo group. In subgroup analysis, the β-lactolin group showed a significant increase in SCFAs including isobutyric acid and isovaleric acid than the placebo group (p=0.033 and 0.035, respectively). Taken together the previous studies, the increases of SCFAs from microbiome and dopamine in the cortex due to β-lactolin might contribute to the improvement of mood state in healthy adults.

Conclusions: The current study is the first to evaluate the effects of β-lactolin on mood state in a randomized placebo-controlled trial. β-lactolin supplementation could be a practical nutritional approach to mitigate stress and anxiety.

Keywords: anxiety, β-lactolin, mood state, peptide, whey

Conflict of Interest Disclosure: YA and TA are employees of Kirin Holdings Company, Ltd., the study sponsor.

This study was funded by Kirin Holdings Company, Ltd. The funder designed this study and supplied the test tablets and placebo. However, the funder had no role in data collection or analysis

OAB(T7)1-5

Attempt to Evaluate Autonomic Nervous System Activity on Intake of Functional Foods Using Empirical Mode Decomposition: A Comparison with Conventional Methods

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Background and objectives: The effects of functional foods on autonomic nervous system activity (ANSA) have been investigated via heart rate variability (HRV). HRV is the variability of heartbeat intervals and includes linear and nonlinear components. In conventional frequency analysis of HRV, the fast Fourier transform (FFT) has been used for linear analysis. Additionally, a combination of FIR filtering and the Hilbert transform (HT) has been used for nonlinear analysis in some studies. Recently, a combination of empirical mode decomposition (EMD) and the Hilbert transform has been proposed as more suitable for nonlinear signals. In this study, the FFT, HT, and EMD analyses were performed on HRV before and after functional food intake, and the results were compared.

Methods: Six healthy young males participated in two experimental sessions with gamma-aminobutyric acid (GABA) or placebo intake. Electrocardiograms were recorded for six minutes each five times before and after intake. A mental arithmetic stress task was applied for 17 minutes starting 13 minutes after intake. HRV data were obtained from the electrocardiograms and three analysis methods were performed. The low frequency band (LF: 0.04–0.15 Hz) component, high frequency band (HF: 0.15–0.4 Hz) component and LF/HF ratio were calculated as indices of ANSA via HRV.

Results: In the EMD analysis, HF and LF/HF ratio were not obtained for only one subject. LF/HF ratio of the subject in the FFT and HT analyses were two to three times higher than that of the other subjects. In another subject, the standard deviation of normal to normal (SDNN), a time-domain index of HRV, was outside the healthy range. LF and HF of the subject were up to 30 times higher than that of the remaining four subjects in the FFT analysis, but up to four times higher in the HT and EMD analyses. In the remaining four subjects, the HT and EMD analyses tended to show less inter-subject variability in all HRV indices compared to the FFT analysis.

Conclusions: We conclude that the HT and EMD analyses offer the possibility of examining parameter changes in HRV in more detail on intake of functional foods.

Keywords: Autonomic nervous system activity, Heart rate variability, Functional foods, Empirical mode decomposition, Hilbert transform

OAB(T7)1-6

Analysis of the mechanism of muscle fiber type determination in muscle satellite cells

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Background and objectives: Muscle fibers are divided into slow muscle fibers and fast muscle fibers. Fast muscle fibers predominantly use glucose for energy. On the other hand, slow muscle fibers predominantly use fatty acids for energy. During sarcopenia, fast muscle predominant muscle atrophy occurs. Muscle satellite cells are undifferentiated stem cells and they are involved in muscle regeneration and hypertrophy. Muscle satellite cells of fast muscles differentiate into fast muscle fibers, and those of slow muscles differentiate into slow muscle fibers. However, the mechanism of how satellite cells differentiate into slow or fast muscle fibers remains unclear. In this study, we performed comprehensive gene expression analysis of satellite cells derived from slow and fast muscle, and searched for factors which are necessary for satellite cells to differentiate into fast muscle fibers.

Methods: We performed comprehensive gene expression analysis of muscle satellite cells derived from EDL (exterior digitorum longus, fast muscle) and SOL (soleus, slow muscle) of C57BL/6J mice. Next, we knocked down Tbx1, Cited1, Hoxa1, and Six2, whose gene expression was higher in satellite cells derived from EDL than those from SOL, by using their respective siRNAs. Finally, we overexpressed Tbx1 in muscle satellite cells derived from SOL by retro-virus infection.

Results: The result of microarray analysis revealed that gene expression of Tbx1, Cited1, Hoxa1, and Six2 was higher in satellite cells of EDL than in those of SOL. Knockdown of Tbx1 decreased gene expression of Myh4 (fast muscle type myosin heavy chain), increased that of Myh7 (slow muscle type myosin heavy chain), and changed the cells to slow muscle-like. On the other hand, gene expression of Myh4 was upregulated, and that of Myh7 was downregulated by overexpression of Tbx1 in satellite cells derived from SOL.

Conclusions: From the above results, we considered that Tbx1 is necessary for satellite cells to differentiate into fast muscle fibers. Decreased ability of muscle satellite cells to differentiate into fast muscle fibers may be the cause of age-related fast muscle predominant muscle atrophy. This study may be helpful to improve age-related fast muscle-dominant muscular atrophy.

Keywords: Muscle satellite cells, fast muscle, slow muscle , transcription factors, differentiation

OAB(T7)1-7

The difference in the cellular uptake of tocopherols and tocotrienols is influenced by their affinity to albumin

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Background and objectives: Vitamin E is classified into tocopherols (Toc) and tocotrienols (T3) based on their side-chain structures. Various cell culture studies have shown that T3 exhibits more potent physiological activities (e.g., antioxidative activity) than Toc, possibly due to its higher cellular uptake compared to Toc. However, the mechanism underlying this difference in cellular uptake remained unclear. In this study, we hypothesized that the affinity of Toc and T3 to albumin might be a possible explanation for their differences in cellular uptake, based on our recent findings that the affinity of some food components to albumin affects their cellular uptake.

Methods: Human acute monocytic leukemia monocytes (THP-1) were incubated under different medium conditions. The affinity of Toc and T3 to bovine serum albumin (BSA) was analyzed by the fluorescence quenching technique and docking model analysis.

Results and discussion: The cellular uptake of T3 was indeed higher than that of Toc in 10% fetal bovine serum (FBS) medium for α-, β-, γ-, and δ-analogs which possess different chromanol rings. In contrast, in serum-free medium, their differential cellular uptake was smaller than in 10% FBS medium. Furthermore, the cellular uptake of Toc decreased when BSA was added to this serum-free medium, whereas the cellular uptake of T3 was significantly increased by the addition of specific BSA concentrations. These results indicated that the difference in the cellular uptake between Toc and T3 is induced by albumin. Results from the fluorescence quenching demonstrated that the affinity of T3 to BSA was higher than that of Toc for α-, β-, γ-, and δ-analogs. Moreover, docking model analysis revealed that this difference in affinity was due to the Van der Waals interaction between their side-chain structures and BSA. Hence, the difference in the affinity of Toc and T3 to albumin, caused by their side-chain structures, might be why T3 demonstrates a higher cellular uptake than Toc.

Conclusions: The difference in the cellular uptake of Toc and T3 is influenced by their different affinities to albumin. The results of this study might give better mechanistic insight into the physiological action of Toc and T3.

Keywords: tocopherol, tocotrienol, cellular uptake, albumin, vitamin E

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)1-8

Impact on milk structuring during gastric digestion on the delivery of CoQ10 to the small intestine, a dynamic in vitro digestion study

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Background and objectives: Milk undergoes major physical changes in the stomach due to interactions of proteins within the gastric environment. The newly formed curd-like structures are shown to affect the rate of delivery of lipids and proteins to the small intestine. The relevance of these structures on modulating the rate of delivery of other components, such as bioactive compounds, is still unknown. Coenzyme Q10 (CoQ10) is a lipid-soluble antioxidant synthetised by the human body. Dietary supplements and functional foods containing CoQ10 are increasing in demand due to their potential health benefits. The objective of this study was to investigate the gastric digestion dynamics of CoQ10-fortified milks and its impact on delivery of CoQ10 to the small intestine.

Methods: Pasteurised skim milk was fortified with two CoQ10-loaded emulsions with different compositions. Milk A contained an emulsion with 20 wt% corn oil, 1 wt% CoQ10, 1 wt% Tween 80. Milk B contained an emulsion with 20 wt% corn oil, 1 wt% CoQ10, 1 wt% sodium casein. Milk was submitted to dynamic *in vitro* gastric digestion using the Human Gastric Simulator (HGS). The physical properties and CoQ10 content of the gastric contents were analysed at different digestion timepoints.

Results: Results showed that the curd formed from milk B disintegrated faster than that formed from milk A. Consequently, milk B emptied from the HGS at a much faster rate than milk A, impacting the delivery of nutrients to the small intestine. CoQ10 was retained within the curd structure, meaning that the disintegration kinetics of the curd during gastric digestion affected the release of CoQ10 into the simulated gastric fluids.

Conclusions: These findings highlight the importance of understanding the disintegration and gastric emptying of foods in the stomach to designing functional foods.

Keywords: CoQ10, milk proteins, in vitro digestions, food fortification, Food structure

Conflict of Interest Disclosure: authors declare no conflict of interest.

OAB(T7)2-1

Effects of a combined eel and tempe flour supplementation on the improvement of protein serum, haemoglobin and IGF-1: An experimental control trials on malnourished rats

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Background and objectives: The study aimed to evaluate the effects of a combined Eel (*Monopterus albus*) and Tempe-soy flour supplementation (CETS) on the level of Protein Serum, Haemoglobin and insulin-like growth factor I (IGF-1) in malnourished rats.

Methods: A combine Eel and Tempe-Soy supplementation with the ratio 1:3.5 was produced by a applying oven drying method. A total of thirty white *Rattus norvegicus* aged 3 - 4 weeks and weighed 40.5 ± 5.4 grams was used in this study, they had poor nutrition (malnourished) as a result of low-protein diet for four weeks (LP; 4% b/b protein). After 4 weeks of treatment, rats were divided into 3 groups (10 rats each group). The rats in group A and B remained on a low-protein diet for 4 weeks, receiving a Low-Protein (LP) (4% b/b protein) diet containing the same amount of calories as a normal diet, and getting doses of CETS of 100 and 200 mg/kgBW respectively orally gavage. Group C or control was given a Normal-Protein (NP) diet (23% b/b of protein) and was allowed to feed ad libitum during the trial period or without a dose of CETS. Blood sample for measuring protein serum, haemoglobin and IGF-1 were collected after 4 weeks of the intervention. Data were analyzed using One-Way ANOVA 95% CI. This study was done at the integrated laboratory of State Islamic University of Sunan Kalijaga Yogyakarta with ethical approval from Pre-clinical Trials Europe (www.preclinicaltrials.eu) No.PCTE0000271.

Results: The results showed that protein serum, haemoglobin and IGF-1 of group B was significantly higher compared to group A and C ($p=0.0021$). Similarly, protein serum, haemoglobin and IGF-1 of group A was significantly higher compared to group C ($p=0.0001$). Doses of 200 mg/kgBW CETS are more effective in increasing levels of protein ($p=0.0052$), haemoglobin and IGF-1 ($p<0.0001$) compared to doses of 100 mg/kgBW.

Conclusions: This implies the a combined Eel (*Monopterus albus*) and Tempe flour supplementation potentially use for improving nutritional status via increasing of Protein Serum, Haemoglobin and IGF-1; and a human clinical study is urgently needed (this dose can be used as a reference for clinical trials).

Keywords: Supplementation, Eel, Tempe, IGF-1, Malnourished

Conflict of Interest Disclosure: Authors declare that there is no conflict of interest in this publication or abstract.

OAB(T7)2-2

Analysis of muscle atrophy inhibiting mechanisms by compounds that suppress transcriptional activity of FOXO1

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Background and objectives: Skeletal muscle is the largest tissue in the human body and plays important roles in exercise, energy metabolism and glucose uptake. Skeletal muscle atrophy, which come about upon aging, bedridden conditions, and inactivity, causes poor quality of life (QOL). Sarcopenia, featuring loss of muscle mass and weakness of muscle strength or physical function, has become a problem in aging society. In our laboratory, we observed remarkable skeletal muscle atrophy in mice with transcriptional factor FOXO1 overexpressed specifically in the skeletal muscle and found FOXO1 as an important factor involved in muscle atrophy. In this study, we screened compound libraries to find compounds that suppress the transcriptional activity of FOXO1. Our purposes are to search for compounds which suppress muscle atrophy and to elucidate those mechanisms.

Methods, results, and discussion: We have established a GAL4-FOXO1 reporter assay system which can evaluate the transcriptional activity of FOXO1. We screened 520 compounds and found novel compounds suppressing transcriptional activity of FOXO1, including active vitamin D_3 ($1,25(OH)_2D_3$). In addition, the transcriptional activity of FOXO3a, which has high homology with FOXO1, was similarly suppressed. Furthermore, in C2C12 myoblasts treated with dexamethasone (DEX), the compounds suppressed the increased expression of the muscular atrophy-related gene (Atrogin1). Therefore, it was suggested that the compounds found in this study that suppress FOXO1 inhibit muscle atrophy. Next, in order to investigate the muscle atrophy suppressing mechanism by these FOXO1 inhibitory compounds, we first focused on $1,25(OH)_2D_3$, which is nutritionally important among the hit compounds. $1,25(OH)_2D_3$ increased the expression of transglutaminase 2, which has been reported to cause muscle hypertrophy. Furthermore, $1,25(OH)_2D_3$ suppressed the degradation of branched-chain amino acids (BCAA) which occur under the state of muscle atrophy. Thus, it was considered that $1,25(OH)_2D_3$ promotes protein synthesis and suppresses muscle atrophy. The compounds found in this study are expected to be used for prevention and improvement of muscle atrophy and to be the basis for understanding the molecular mechanism of muscle atrophy suppression by compounds.

Keywords: FOXO1, muscle atrophy, compounds, $1,25(OH)_2D_3$

OAB(T7)2-3

Effect of cyclic sugars with different number of glucose units on gut IgA secretion

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Background and objectives: Cyclic nigerosylnigerose (CNN), α-cyclodextrin (CD), β-CD, and γ-CD are cyclic sugar that consists of 4, 6, 7, and 8 glucose units, respectively. A previous study revealed that oral administration of CNN increases immunoglobulin A (IgA) concentration in mice feces. IgA is a major antibody secreted into the gut and contributes to symbiosis with bacteria. In this study, we compared the effect of cyclic sugars with a different number of glucose units on gut IgA secretion.

Method: Balb/c mice were divided into 5 groups and fed a control diet or a cyclic sugar-supplemented diet for 12 weeks. The feces were collected at week 6 and 12, and suspended with PBS. The fecal supernatant was collected by centrifugation. The IgA concentration in the supernatant was measured by ELISA. At week 12, mice were sacrificed and the colonic tissue and cecal content were collected. The expression of genes related to IgA class switching including *April*, *Tgfb1*, and *Aldh1a2* in the colon was measured by qPCR. The concentration of short-chain fatty acids including acetic acid, propionic acid, and butyric acid was measured by gas chromatography.

Results: The IgA concentration in CNN group was significantly higher than Control, α-CD, and β-CD group at week 6 and than Control and α-CD group at week 12. There was no significant difference in the gene expression of *April* and *Tgfb1* between CNN group and other groups, while that of *Aldh1a2* was significantly higher in CNN group than α-CD, β-CD, and γ-CD group. The butyrate concentration in the cecal content was significantly higher in CNN and α-CD group than in Control, β-CD, and γ-CD group.

Conclusion: CNN exerts a stronger stimulatory effect on gut IgA secretion than α-CD and the effect lasts for 12 weeks after administration. The stimulatory effect of cyclic sugar on gut IgA secretion isn't determined in the number of glucose units-dependent manner. CNN may promote gut IgA secretion via increasing an enzyme expression related to IgA class switching and modifying bacterial fermentation.

Keywords: cyclic suger, immunoglobulin A, gut bacteria

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)2-4

Suppression of alcohol consumption in mice by foods capable of increasing FGF21 secretion

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Background and objectives: Alcohol use disorder (AUD), which is a condition characterized by uncontrollable alcohol drinking, has been studied traditionally in the context of drug addiction but has not yielded effective medical treatments. Therefore, to address AUD, new research strategies and interventions are needed.

Alcohol is usually consumed together with food in healthy people. Therefore, alcohol drinking could be investigated as ingestive behavior, and this research approach may yield new interventions for AUD that had not been yielded by the drug addiction research. However, physiological mechanisms that control alcohol drinking remain elusive.

Fibroblast growth factor 21 (FGF21) and oxytocin (OXT) individually has been reported to reduce the intake of sugar and alcohol. We previously reported that the FGF21-OXT system regulates preference for sugar; therefore, we tested if the FGF21-OXT system also regulates alcohol drinking. Furthermore, AUD patients may accept food intervention than medications: we searched for FGF21-inducing food ingredients and tested their effect on alcohol drinking.

Methods: We generated OXT neuron-specific FGF21 receptor-deficient (KO) mice by mating *Oxt-ires-Cre* mice with *βKlotho-flox* mice. The preference for alcohol was assessed by two-bottle choice test (water vs. alcohol). Rare sugars for FGF21-inducing ability were screened using primary hepatocytes of wild-type (WT) mice. FGF21 levels in cell culture media or plasma samples were measured using ELISA kit.

Results: KO mice significantly increased alcohol preference. We next screened 46 rare sugars for FGF21-inducing ability. Four rare sugars, d-sorbitol, d-xylitol, d-tagatose and d-allulose, significantly induced FGF21 secretion from primary hepatocytes compared to fructose. Moreover, oral administration of these rare sugars to WT mice significantly increased blood FGF21 levels, while oral administration of d-tagatose and d-allulose decreased alcohol preference. We also searched for a mixture of food ingredients that can induce FGF21 more effectively. We tested the mixture of black vinegar (BV) and kome-koji amazake (KA), both of which are non-alcoholic and fermentation products of rice or ricemalt. Oral administration of 5% BV/50% KA solution to WT mice significantly increased blood FGF21 level and decreased alcohol preference.

Conclusions: These data suggest that d-tagatose, d-allulose and BV/BA mix solution, which may stimulate FGF21-OXT system, suppresses alcohol drinking.

Keywords: FGF21, Oxytocin, Alcohol preference, Rare sugar

OAB(T7)2-5

Novel soy peptides that improve cognitive function after oral administration

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Background and objective: Healthy aging is important for the increasing elderly population worldwide. We found that the enzymatic digest of soy β-conglycinin administered orally improves cognitive decline in mice. We then searched for peptides present in the digest that can improve cognitive function.

Methods: Cognitive function was evaluated by behavior tests, such as the novel object recognition test (ORT) and the object location test (OLT), using male mice. We investigated whether orally administered samples improved cognitive decline in mice that were treated with high fat diet (HFD) for one week [1]. The candidate peptides were synthesized by Fmoc strategy and purified by reverse phase HPLC.

Results: Based on the comprehensive analysis information of the digest [2] and homology with known peptides that improve cognitive decline, candidate peptides were chemosynthesized. Among them, we found one decapeptide and one dodecapeptide increased the approach time to the new object after oral administration in mice fed with HFD diet. Thus, we found that these peptides improved cognitive decline induced by HFD intake in the ORT. In the OLT, we also found that they improved cognitive decline. Thus, we demonstrated that the peptides were effective in improving cognitive decline by using different two paradigms.

Acetylcholine (ACh) is known to be a neurotransmitter that plays a critical role in cognitive function. To investigate the involvement of the acetylcholine system, methyllycaconitine (MLA), an antagonist specific for the a7 nicotinic ACh receptor (a7nAChR), was used. Both the soy β-conglycinin digest and the synthetic peptide improved cognitive decline induced by HFD intake, and these improvements were blocked by MLA. These results suggest that the improvements were associated with the a7nAChR system.

Conclusion: we found novel soy protein-derived peptides improving cognitive decline and the effect of peptide is coupled to the acetylcholine system.

Keywords: β-conglycinin, orally active peptides, novel object recognition test (ORT), object location test (OLT), alpha7 nicotinic acetylcholine receptor

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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)3-1

Effects of the dietary flavonoids with natural prostaglandin D_2 and its synthetic analogues on the fat storage during the differentiation phase of cultured preadipocytes.

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Background and objectives: Dietary flavonoids exert anti-adipogenic effects on culture adipocytes that could provide health benefits for humans. However, it is unclear whether there is direct interaction of flavonoids with biosynthetic prostaglandin (PG) in 3T3-L1 preadipocytes. PGD_2 is an unstable metabolite of arachidonate-cyclooxygenase pathway that interacts with cell-surface membrane receptors, DP1 and DP2 / CRTH2 in adipocytes to regulate adipogenesis program. The aim of study is to investigate the anti-adipogenic mechanism of dietary flavonoids focusing on the interaction with natural PGD_2 and its synthetic analogues in mouse 3T3-L1 model.

Methods: The inhibitory effect of anti-adipogenic flavonoids (quercetin, apigenin and isovitexin) on PGD_2 or its isosteric analogue, 11-deoxy-11-methylene-PGD_2 or its another synthetic analogue acting as CRTH2 agonist, 15(R)-15-methyl-PGD_2 along with a well-known cyclooxygenase-inhibitor aspirin, was examined after their supplementation in cultured preadipocytes for 45-hours during the differentiation phase (pretreatment), and determined quantitatively the fat storage in matured adipocytes after 6 days of the maturation phase. The protein amount in cultured adipocytes was quantified by Lowry method. The data of cellular fat content was normalized to cellular protein content and expressed as mg-triacylglycerol per mg-protein.

Results: This study found the significant suppressed adipogenesis after co-incubation of flavonoids with aspirin during the differentiation phase compared to control cells. Similarly, pretreatment of flavonoids with PGD_2 and aspirin effectively inhibited the lipid accumulation in mature adipocytes. The fat storage repressed by PGD_2 was attenuated by co-existence of flavonoids with either of both synthetic PGD_2 analogues in cultured adipocytes. The pretreatment of flavonoids with 15(R)-15-methyl-PGD_2 and aspirin cancelled significantly the suppressive effect of triacylglycerol level by PGD_2. Moreover, this recovery of adipogenesis was more effectively exerted by isovitexin, a C-glycosidic apigenin when compared to aglycones, quercetin and apigenin in the treated cultured preadipocytes.

Conclusions: The inhibition of adipogenic effect by pretreatment of flavonoids along with exogenous PGD_2 and cyclooxygenase-inhibitor suggests synergistic or additional effects of flavonoids exerted to PGD_2 in preadipocytes during the differentiation phase. These findings implicate involvement of signaling pathway by DP receptors for the interaction of dietary flavonoids with endogenous prostaglandins in the control of adipogenesis program in 3T3-L1 cells.

Keywords: Dietary flavonoids, Prostaglandins, Adipogenesis, 3T3-L1 preadipocytes, Differentiation phase.

OAB(T7)3-2

Effect of specifically designed prebiotic foods on human gut microbiota composition

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Background: The gut microbiota is the set of microorganisms that inhabit the intestine, in symbiosis with the human body, playing a relevant role in several of its functions including energy homeostasis and inflammation regulation. However, there are many microbiota profiles due to individual variances, that define various enterotypes; and the effects of specific dietary patterns and foods are still mostly unknown.

Objectives: In the context of the BIOTAGUT project, we have designed eight specific foods with potential prebiotic activity whose capacity to modulate the intestinal microbiota was evaluated in vitro and in vivo.

Methods: The capacity of the eight foods (three functional drinks based on fruits and vegetables, two breads, one herbal infusion, a *Bifidobacterium* yogurt, and bimi) to modify gut microbiota and metabolome composition was tested in an in vitro simulator of the human gastrointestinal tract (Ainia, Valencia, Spain). After that, a total of 120 Spanish volunteers were recruited and divided into 8 groups of 15 volunteers each. Each group was assigned to a different prebiotic food that was included in their habitual diet for 3 weeks. The effects of the experimental foods on gut microbiota were studied by analyzing the hypervariable regions V3–V4 of the prokaryotic 16S rRNA gene in fecal samples collected before and after the 3-week period.

Results: The intake of the all the experimental foods had an impact on the composition of the gut microbioma, and in some cases also in the diversity and richness. However, most of the individuals kept the same microbial enterotype before and after the treatment.

Conclusions: The experimental foods had a mild influence on bacterial species and genus composition, diversity and richness, without the risk of causing a microbial imbalance or even a dysbiosis. The results strongly support the technical procedure (first in vitro, secondly in vivo) to design new functional foods with potential prebiotic activity. Also, this study demonstrates that the intake of specifically designed prebiotic foods constitutes a novel strategy to modulate gut microbiota composition and to revert dysbiotic states with the ultimate goal of providing a benefit for the host.

Keywords: Colonic fermentation, Gut microbioma, Metabolomics, Dysbiosis, Enterotype

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)3-3

The Effect of Enzymatically Modified Isoquercitrin on Brain Function via Changing Gut Microbiota and Blood Metabolites in Mice

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Background and objective: The brain controls every process regulating our body, and there are many factors influencing brain development, of which diet plays a vital role in affecting brain function. Enzymatically modified isoquercitrin (EMIQ), composed of isoquercitrin and its glycosylated derivatives, is widely used as a food additive, and it has various biological activities such as anti-oxidant, anti-inflammatory, and anti-obesity. However, the data on the effect of EMIQ on brain function is limited. In this study, we investigated the effect of EMIQ on brain function and the potential mechanism.

Methods: Five-week-old male C57BL/6 mice were treated with 0, 0.005%, and 0.05% EMIQ in drinking water for 4 weeks. The behavior test, Real-time PCR, gas chromatography-mass spectrometry (GC-MS), Western blotting and Next Generation Sequencing were used in this study.

Results: The behavior test showed that 0.05% EMIQ treatment significantly improved mice memory function than the control group without affecting mice emotion. This effect was possibly associated with an attenuation in oxidative stress in the hippocampus; as evidenced by changes in the gene levels of superoxide dismutase 1, nuclear factor-erythroid factor 2-related factor 2, and cyclooxygenase 2 by real-time PCR. Interestingly, a metabolite, taurine, was identified that was significantly increased in the 0.05% EMIQ group using GC-MS. Western blotting further showed that taurine could protect SHSY5Y neuroblastoma cell lines against oxidative stress induced by lipopolysaccharide via anti-oxidant activity *in vitro.* EMIQ caused significant alterations in the gut microbiota composition, especially increasing the abundance of genera *Akkermansia*, *Bifidobacterium*, and *Adlercreutzia*, but did not change the alpha-diversity of the microbiota. The correlation analysis revealed that the increase of serum taurine was closely associated with the abundance of the *Akkermansia genus* in the gut microbiota.

Conclusion: Taken together, EMIQ could increase serum taurine metabolism influenced by the gut microbiota composition to improve memory function via the gut microbiota-blood-brain axis. Our result will provide a novel view for understanding the effect of EMIQ on brain function.

Keywords: EMIQ, memory, metabolites, taurine, gut microbiota

OAB(T7)3-4

Effects of fermented rice bran extracts on colonic barrier integrity and gut microbiota in chronic sleep deprived mice

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Background and objectives: Chronic sleep deprivation (SD) is prone to result in compromised colonic barrier integrity and imbalanced gut microbiota. However, fermented rice bran (FRB) was found to be alleviating sleep disorders and maintaining intestinal integrity. Thus, in this study we investigated the effects of FRB extracts on colonic barrier integrity and gut microbiota in chronic sleep deprived mice.

Methods: This study used male C57BL/6 mice given AIN-93M diet or FRB diet containing modified AIN-93M diet with 1% or 5% FRB extracts (*w/w*). Mice were divided into four groups, including normal control (NC), SD, SD+1% FRB, and SD+5% FRB group. After 2 weeks of feeding, mice in the three SD groups were received chronic SD by modified multiple platform method (MMPM) for 6 weeks (16 hours/day, 5 days/week). Mice were sacrificed after the chronic sleep deprivation program.

Results: Chronic SD caused increased stress hormone corticosterone and lipopolysaccharide (LPS), but reduced serotonin levels in plasma. The gene expression of tight junction protein (zonula occludens-1, ZO-1) also decreased in cecum. The richness of gut microbiota in SD group was significantly higher than NC group, and distribution between NC and SD group was obviously different. Compared to NC group, *Bifidobacterium* (genus), *Muribaculaceae* (family), *Dubosiella* (genus), *Faecalibaculum* (genus), *Akkermansia* (genus) were lower, while Lachnoclostridium (genus) were higher in SD group. FRB extracts supplementation decreased corticosterone and LPS, but enhanced serotonin levels in plasma. It also reversed the gene expressions of ZO-1, aryl hydrocarbon receptor (AhR) and antimicrobial peptide (cathelicidin) in cecum or colon. The distribution of gut microbiota in FRB groups were obviously different from SD group. Compared to SD group, lower *ASF356* (genus), *Bifidobacterium* (genus), *Erysipelatoclostridium* (genus), *Enterococcus* (genus), *Faecalibacterium* (genus), and higher *Prevotellaceae_UCG-001* (genus), *Bacillus* (genus), *Candidatus_Saccharimonas* (genus), *Succinivibrio* (genus), *Akkermansia* (genus), *Tannerellaceae* (family) were found in SD+1% FRB or/and SD+5% FRB groups.

Conclusions: These findings suggested that supplementation of FRB extracts modulated gut microbiota, reduced chronic SD-induced stress, and consequently improved gut microbial translocation.

Keywords: fermented rice bran extracts, chronic sleep deprivation, colonic barrier integrity, gut microbiota

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)3-5

Potential benefits of epidermal growth factor in alcoholic liver disease induced muscle loss

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Background and objectives: Muscle loss is widely occurrence in alcoholic liver disease (ALD) patients. The damages of muscle in ALD majorly result from endotoxemia caused by leaky gut and hyperammonemia. Epidermal growth factor (EGF) is proposed as health-improvement factors in previous studies. Therefore, in this study, potential beneficial effects of EGF on muscle wasting in ALD were assessed by muscle degradation and synthesis as well as intestinal microbiota diversity.

Methods: Six weeks old male Wistar rats were divided into five groups (n=10) according to alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities without differences. All five groups were fed with control liquid diet for first two weeks, and three of them were fed with diets containing EGF. Afterwards, two liquid diet groups without EGF were fed following by control or Lieber–DeCarli alcohol liquid diet as control (C) and ethanol (E) groups respectively. The groups with EGF feeding were further assigned to continually given the same (AEGF-C), ethanol liquid diet without EGF (PEGF-E) and ethanol liquid diet with EGF (AEGF-E).

Results: E group had higher plasma alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities, plasmatic endotoxin and ammonia (p <0.05). H&E stain also indicated more hepatic fatty change and inflammatory cells, along with escalated interleukin 1ß (IL-1ß) in E group. While plasma endotoxin, IL-1ß and IL-6 levels were inhibited in PEGF-E and AEGF-E groups. Also, plasma lipid peroxides and inflammatory cells accumulation were significantly decreased in PEGF-E (p <0.05). The degradation markers (MURF and atrogin-1) illustrated the damage of E group in muscle. In both PEGF-E and AEGF-E groups, MURF and atrogin-1 were significantly inhibited. From microbiota aspects, α-diversity did not differ among all groups. However principal co-ordinates analysis (PCoA) showed that gut microbiota were distinct between alcohol consumption groups (E, PEGF-E and AEGF-E) and those without alcohol (C and AEGF-C). In addition, PEGF-E showed the less differences with C group.

Conclusions: Chronic alcohol feeding led to significant liver injury, muscle degradation and gut microbiota changes. It was assumed that EGF as pretreatment or supplement could alleviate muscle degradation by means of ameliorating liver inflammation, reducing endotoxin translocation, and altering microbiota composition.

Keywords: ethanol, epidermal growth factor, alcoholic liver disease, microbiota, rat

OAB(T7)3-6

Diallyl trisufide, a Garlic (*Allium sativum* L.) derived organosulfur compound suppresses extrinsic coagulation and arteriosclerosis

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Background and Objectives: The balance of the blood coagulation/fibrinolysis system determines the fluidity of blood in the vessels. Increased coagulation and/or decreased fibrinolysis cause thrombotic diseases. In addition, the risk of thrombosis increases with the progression of aged-dependent arteriosclerosis. Cardiovascular diseases are the major cause of morbidity and mortality worldwide; the number of deaths per year is anticipated to be over 23.6 million by 2030. Extrinsic blood coagulation pathway is triggering the thromboembolism based on arteriosclerosis. Tissue factor (TF) is a critical initiator of the extrinsic coagulation. Diallyl trisulfide (DATS) is a secondary metabolite of allicin generated in crashed garlic (*Allium sativum* L.). DATS has various pharmacological activity such as anti-platelet aggregation. This study aimed to clarify the effect of DATS on extrinsic coagulation elicited by TF and on the arteriosclerosis to know the property of garlic in cardiovascular diseases.

Methods: The effect of DATS on TF activity was measured by clotting assay using TF-expressing HL60 cells. HL60 cells were incubated for 6 h with PMA to induce TF expression. This HL60 cell suspension was treated with DATS then incubated with $HgCl_2$ to activate TF. Bovine plasma was added to the cell suspension mixture, and TF activity was measured as a function of clotting time. TF and arteriosclerosis relating protein expressions in TNF-α-stimulated human umbilical vein endothelial cells (HUVECs) was examined by qPCR and western blotting. The effect of DATS on arteriosclerosis was also examined by using apolipoprotein E-deficient mice. Serial cryosections of the tricuspid valve of the mice were stained with haematoxylin and eosin for plaque morphology and Oil Red O for lipid deposition, and staining was evaluated.

Results: DATS inhibited TF activity induced by PMA in a dose-dependent manner. TF mRNA/protein expression in TNF-α-stimulated HUVECs were also inhibited by DATS. It has also suggested that DATS suppresses TF expression through the inhibition of JNK signals induced by TNF-α. Induction of mRNAs encoding cell adhesion molecules such as Vcam-1 was also suppressed by DATS in the TNF-a-stimulated HUVECs. The size of atherosclerotic lesion in the apolipoprotein E-deficient mice tended to be reduced by DATS administration in comparison with vehicle treated control mice.

Conclusion: DATS may serve as a dietary constituent with beneficial effects on vascular disease elicited by extrinsic coagulation.

Keywords: garlic, diallyl trisulfide, tissue factor, arteriosclerosis, cardiovascular diseases

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)3-7

Appetite-suppressing effects of dietary GABA and GABA degradation inhibition in lean and obese mice: a potential strategy for obesity treatment

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Background and objectives: Overeating is one of the major factors causing overweight and obesity. However, controlling food intake for weight loss is often difficult to achieve and maintain for obese individuals. We previously found that a high dose (5%) of gamma-aminobutyric acid (GABA) mixed in a normal diet significantly decreased food intake and body weight in lean mice and elevated blood GABA levels. In this study, we examined whether an increase in blood GABA levels, not distaste for the food, is a key factor of appetite suppression.

Methods and results: To increase blood GABA levels, lean-male-ICR mice fed with 2% GABA diet (20 g GABA/kg diet) were administered vigabatrin, a GABA-degradation inhibitor. In the control (no GABA in diet) and 2% GABA without vigabatrin groups, GABA was present in trace concentrations (0.7 ± 0.2 µM). However, 2% GABA diet plus vigabatrin inhibited GABA degradation, thereby significantly increasing blood GABA levels (68.7 ± 12.8 µM). Interestingly, 2% GABA diet plus vigabatrin significantly suppressed food intake (−50%, $P < 0.05$) and body weight gain (−28%, $P < 0.05$) within 2 weeks, whereas no significant differences were observed in food intake and body weight between the control and 2% GABA groups. Moreover, a decrease in food-seeking behavior was observed in the 2% GABA plus vigabatrin-fed mice. Next, we examined these effects in obese mice. Eight-weeks-high-fat-diet-induced-obese-ICR mice were divided into four groups receiving a high-fat diet (control) or a high-fat plus 2% GABA diet with or without vigabatrin administration. We observed that 2% GABA diet plus vigabatrin significantly suppressed food intake (−59%) and body weight gain (−21%) within 2 weeks in obese mice as well, whereas no effects on food intake and body weight were observed in the control and only 2% GABA diet groups. Notably, vigabatrin administration with the control diet (no GABA) suppressed body weight gain by only 5%, suggesting that vigabatrin is not the main effector.

Conclusions: Dietary GABA with GABA-degradation inhibition induces the appetite-suppressing and weight-loss effects in both lean and obese mice. These effects are mainly attributed to blood GABA availability and GABA-degradation inhibition, not food distaste. Our findings may aid the development of appetite-controlling interventions for obesity management.

Keywords: dietary GABA, GABA degradation, appetite, weight loss, obesity

Conflict of Interest Disclosure: There is no conflict of interest.

OAB(T7)3-8

Effect of high protein and low carbohydrate smoothie drinks versus a diabetes-specific nutritional formula on postprandial glucose homeostasis in type-2 diabetic patients

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Background and objectives: The prevalence of type 2 diabetes mellitus has increased drastically in the past decade. Achieving optimal glycemic control is the challenges for patients with diabetes. Most of them have overweight or obesity which worsen insulin resistance and diabetes complications. Nutrition supplement is an alternative nutrition therapy, specifically manufactured for diabetic patients to help control blood sugar. We aimed to determine the effect of high protein and low carbohydrate smoothie drinks on glucose homeostasis, insulin and lipid metabolism in obese type 2 diabetic individuals as compared with a diabetes-specific nutritional formula.

Methods: We compared between a regular high protein smoothie drink (SM) containing 39% carbohydrate, 24% protein and 37% fat or a high protein and low sugar smoothie drink (LS) containing 28% carbohydrate, 28% protein and 44% fat with a conventional diabetic enteral drink (Glucerna) containing 38% carbohydrate, 18% protein and 33% fat. A crossover design study was performed in 41 diabetic participants. Participants consumed 300 kilocalories of each drink at a time with one-week wash out period between drinks and glucose response curves at baseline, 30, 60, 90, 120, 180 and 240 minutes were monitored and compared.

Results: In all three diets blood glucose levels gradually decreased postprandially. Average postprandial plasma glucose levels and the area under the curve (AUC) were higher after Glucerna and SM intake as compared with LS (p-value < 0.05) which demonstrated that LS be the better insulin sensitive formula among of the three formulas. The peak blood glucose level was highest at 60 minutes after Glucerna (175.5 ± 5.38 mg/dL) intake when compared with SM (173.8 ± 5.79 mg/dL) and LS (160.8 ± 5.77 mg/dL), respectively (p-value < 0.0001).

Conclusions: These results suggested the potential of smoothie formulas containing high protein and low carbohydrate for the nutritional support of type 2 diabetes mellitus and its related glycemic control. These smoothies may be a good candidate as promising functional foods for the management and supplementation for diabetes and obese people in the future.

Keywords: Clinical nutrition, Smoothie drink, Meal replacement, Medical food, Diabetes

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T7)4-1

Effects of n-3 LCPUFAs Supplementation on the Body Composition and Fitness Performance in Malaysian Football League Players Undergoing Regular Training

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Background and objective: A proper nutrition plan will play a prime role in enabling football players to manage the training loads and to improve performance on match days. The omega-3 has shown a potential sports nutrition supplement for performance, recovery and injury prevention. The present randomised controlled trial aimed to assess the effects of 8 weeks of supplementation on n-3 long-chain polyunsaturated fatty acids (n-3 LCPUFAs) on the body composition and exercise performance of professional males footballers.

Methods: A total of 27 professional male footballers from Selangor Football Club were randomly assigned into 2 groups: placebo (n=14), and n-3 LCPUFAs (n=13). The n-3 LCPUFAs supplement contained 2.1g of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) (1.5g EPA+600mg DHA) were administered in 6 capsules (4 in the morning and two in the evening, 30 min after a meal). The body composition and physical exercise performance of footballers were measured at week 0, week 4 and week 8.

Results: There were no significant differences found between the groups of footballers for anthropometry or body composition components when compared to baseline (p >0.05). The ANCOVA analysis showed that the n-3 LCPUFAs group had significantly higher levels of EPA and DHA when compared to the placebo group at week 8. The aerobic capacity showed significant between-group differences with a large effect size (placebo vs n-3 LCPUFAs group: 69.9 ± 6.5 vs 75.9 ± 6.8, p = 0.021, d = 0.91, large effect).

Conclusion: The n-3 LCPUFAs supplementation improved the exercise performance, particularly on aerobic capacity among the footballers. Future studies also should investigate the protective effect on muscle fatigue during and after exercise as well as the muscle inflammatory reaction.

Keywords: n-3 LCPUFAs, exercise performance, body composition, footballers

Conflict of Interest Disclosure: The study was funded by BASF Newtrition® Asia Research Grant without any no role in the data collection, analysis, or interpretation of data and the writing of the manuscript.

OAB(T7)4-2

Capsaicin alleviates cisplatin-induced muscle loss and atrophy In vitro and In vivo

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Background and objectives: Cisplatin (CP) is a widely used chemotherapeutic drug with subsequent adverse effects on different organs and tissues including skeletal muscle loss and atrophy as the most common clinical symptoms. The molecular mechanism of cisplatin-induced muscle atrophy is not clearly understood. However, recent significant advances indicate that it is related to imbalance in both protein status and apoptosis. Capsaicin (CAP), is one of the major ingredients in chili peppers. It is a valuable pharmacological agent with several therapeutic applications in controlling pain and inflammation with particular therapeutic potential in muscle atrophy. However, the mechanisms underlying its protective effects on cisplatin-induced muscle loss and atrophy remain largely unknown. The purpose of this study was to investigate the beneficial effects of capsaicin on cisplatin-induced muscle loss and atrophy both in vivo and in vitro.

Methods: Male C57BL/6J mice (5 weeks old) included capsaicin (10 and 40mg/kg, for 5weeks) administration as pretreatment to cisplatin (5mg/kg BW, for 7 days)- induced muscle atrophy animal model for protein and oxidative stress examination as well as grip strength to evaluate the muscle strength. Moreover, we utilized an in vitro C_2C_{12} pretreated with capsaicin (10, 25, 50 μM) and treated with cisplatin (40 μM) myotube formation model where cell viability analysis, immunofluorescence and protein expression were measured to investigate the effect of capsaicin in hampering cisplatin-induced muscle atrophy.

Results: Our study results indicated that cisplatin caused lower cell viability and showed a subset of hallmark signs typically recognized during atrophy, including severe reduction in myotube diameter, repression of Akt and mTOR protein expression. However, pretreatment with capsaicin could ameliorate cisplatin-induced muscle atrophy by up-regulating Akt (up to 1.4 fold, p <0.01) and mTOR (up to 1.8 fold, p <0.01), which stimulates protein synthesis in skeletal muscle as well as down-regulating Myostatin, MAFbx, MuRF-1 (decrease more than 2 folds, p <0.01), the markers of protein degradation. Also, Capsaicin was able to downregulate protein expression of apoptosis related markers (decrease more than 3 folds, p <0.01) which are induced by cisplatin. In Vivo, capsaicin could relieve the oxidative stress and cytokine secretion (up to 1.6 fold, p <0.01) while modulating the autophagy related lysosome fusion. Moreover, Capsaicin improved the grip strength and alleviated cisplatin-induced body weight loss and gastrocnemius atrophy.

Conclusion: These findings suggest that cisplatin can restore cisplatin induced imbalance between protein synthesis and protein degradation pathways, and it may have protective effects against cisplatin-induced muscle atrophy.

Keywords: Capsaicin, Cisplatin, Myotube, Muscle atrophy

OAB(T7)4-3

Gut microbial metabolism of *in vivo* digested cocoa (poly)phenolics yields bioactive metabolites.

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Background and Objectives: Cocoa is a rich source of flavan-3-ols, whose beneficial effects on human health are likely due to their metabolites including phenyl-γ-valerolactones (PVLs) and phenyl valeric acids (PVAs). Ileostomy studies provide unique insights into *in vivo* food digestion, allowing identification of physiologically relevant dietary phytochemicals and their metabolites, including PVLs and PVAs. Therefore, the objective of this study was to investigate the bioavailability of (poly) phenols from a cocoa-based drink in the upper GIT tract *in vivo* and the of lower GIT using *ex vivo* modelling of (poly)phenol enriched ileal fluid.

Methods: Ileal fluids collected from 5 volunteers before and after (0-8 hr) intake of a flavanol-containing cocoa-based drink, underwent an anaerobic temperature and pH controlled faecal batch fermentation (24 hr). Samples collected after 0, 5, 10 and 24 hr were analysed using 16S rRNA gene sequencing for the microbiome composition and UHPLC-HR-MS for identification/quantification of (poly) phenolic compounds. The ileal samples were obtained from a randomised, double-blinded, two-way crossover acute feeding study (NCT03765606). Ten ileostomates consumed a flavanol-containing cocoa-based drink and a de-xanthinated cocoa-based drink (566 mg or 583 mg of flavan-3-ols, respectively), ileal fluids were collected 0, 0-4, 4-8, and 8-24 hours after consumption and their (poly) phenolic content characterised via UHPLC-MS/MS.

Results: Characterisation of the ileal fluids (poly) phenolic content showed that a significant proportion of the ingested flavan-3-ols reached the colon as methoxy- and/or sulphated-metabolites, with significant inter-individual variability evident. Fermentation of cocoa enriched ileal fluid (0-8h) using an in vitro gut model resulted in minimal changes to relative abundance in microbiota at phylum and genus level and significant increases in flavan-3-ol metabolites especially 3',4'-dihydroxyphenyl-γ-valerolactones. Such Increases in flavan-3-ols metabolites were significantly correlated with gut microbiota genera including *Faecalibacterium* and *Butyricimonas*.

Conclusion: Consumption of cocoa resulted in significant amount of flavanols being available to enter the colon. Twenty-four hour *ex vivo* fermentation of ileal fluids post-cocoa consumption resulted in significant increases in flavan-3-ols metabolites especially, 3',4'-dihydroxyphenyl-γ-valerolactones which were associated with specific bacterial genera.

Keywords: flavan-3-ols, Cocoa, Ileostomate, Gut microbiota, Bioavailability

Conflict of Interest Disclosure: None

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OAB(T7)4-4

Development of a food product with probiotic potential and its effect on parameters associated with glucose homeostasis in patients with type 2 diabetes mellitus at the Clinics Hospital of Paraguay

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Background and objectives: Type 2 diabetes mellitus (T2DM) is one of the major health problems worldwide with high morbimortality rates. In fact, several studies link metabolic diseases with intestinal dysbiosis suggesting that certain bacterial strains could play a beneficial role on metabolic parameters (through modulation of the intestinal microbiota). Our objective was to develop a food product containing strains with probiotic potential and to study the effect of its consumption on parameters associated with glucose homeostasis.

Methods: 46 subjects with T2DM from the Endocrinology Department of Clinics Hospital (Paraguay) were included and randomly assigned to three different intervention groups. The first group received 300 g/d of fermented dairy with two strains of the genus *Bifidobacterium* (developed exclusively for this research purpose by the Cooperativa Chortitzer Ltda ¨Lácteos Trebol¨, Paraguay). The second group received 300 g/d of a fermented dairy with conventional cultures, and the third group did not receive any type of fermented dairy. Also, all three groups received nutritional monitoring based on the recommendations of the American Diabetes Association (ADA) during a 12-week intervention period. Biochemical parameters related to lipid profile and glucose homeostasis were determined at baseline and after the follow-up period. Repeated measures analysis and Pearson correlation of the biochemical parameters included in the study were performed.

Results: The results showed that the intake of the developed product induced in the patients a decrease in the HOMA index, although not significant, in contrast to the intervention without fermented dairy which induced a statistically significant increase in the HOMA index after the intervention period compared to baseline (p=0.016). Furthermore, in the baseline situation of the study, a positive correlation between glycemia and CRP levels (p=0.025; r_2=0.576) and HbA1c and CRP (p=0.003; r_2= 0.707) was observed in patients who had consumed the developed dairy.

However, these correlations lost significance after the intervention period.

Conclusions: The consumption of the food product developed with two strains of the genus *Bifidobacterium* would have potential as a nutritional tool in clinical practice, since it could improve glucose homeostasis in patients with diagnosed type 2 diabetes mellitus.

Keywords: probiotics, intestinal microbiota, Type 2 diabetes mellitus, glucose homeostasis

OAB(T7)4-5

Procyanidin C1 ameliorates bisphenol A-induced developmental toxicity and mitochondrial malformations in zebrafish embryos

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Background and objective: Consumers around the world are unknowingly exposed to bisphenol A (BPA) via food and beverage containers, and other products. BPA may be harmful to human health because of its ability to disrupt normal biological processes and normal behavioral states, cause DNA damage, and alter epigenome profiling. Procyanidin C1 (PCY1) has been shown in studies to be capable of neutralizing free radicals, mitigating the effects of environmental toxins, and protecting cells from DNA damage. However, little is known about its effects on mitigating developmental toxicity and cytoskeletal malformations in developing embryos, which can disrupt embryonic cleavage and result in developmental failure. Therefore, the purpose of this study is to determine the effects of PCY1 intervention on embryonic development, mitochondrial distributions, and the expression of apoptotic (*baxa, bcl2a, casp3a*, and *tnfa*) and mitochondria-related (*etfa, mfn2*, and <*pink1*) genes in BPA-exposed zebrafish embryos.

Methods: Ninety-six (n=96) zebrafish embryos were employed in this study. Toxicology evaluation of the embryos was performed using the Zebrafish embryo acute toxicity test (ZFET). Every 24 hours until the 96th hour of exposure, toxicological endpoints were monitored. Hatching and heart rate were observed as early as 48 hours after conception, and teratogenicity was discovered at 120 hours. Total RNA was isolated, converted to cDNA, preamplified, and processed with a microfluidic quantitative real-time polymerase chain reaction (qRT-PCR). BioMark Real-Time PCR Analysis Software 4.3.1 was used to analyze the genes.

Results: The study found that, PCY1 intervention improves embryonic development in BPA-exposed conditions by reducing embryonic mortality and malformations. PCY1 intervention significantly reduced the expression of the genes *baxa*, and *casp3a.* Moreover, *bcl2* and *tnfa* were significantly up-regulated. The PCY1 intervention group also had significantly lower expression of the *etfa, mfn2*, and *pink1* genes.

Conclusions: It has been demonstrated that PCY1 can minimize the negative effects of BPA on embryonic development and mitochondrial malformations. Hence, the findings concluded that PCY1 may play a role in protecting embryos from the harmful effects of BPA.

Keywords: Procyanidin C1, Bisphenol A, Mitochondrial malformations, Developmental toxicity, Zebrafish embryos

OAB(T7)4-6

Role of nutraceuticals in the management of dyslipidemia- A meta-analysis

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Background: Dyslipidemia is one of the major risk factors for non-communicable diseases (NCD). Its worldwide prevalence depicts that 40% female and 37% male population have raised cholesterol mainly associated with NCDs like cardiovascular diseases, hypertension, diabetes, fatty liver, inflammatory bowel syndrome (IBS), obesity, hypothyroidism, cancers, osteoarthritis, stroke, cerebrovascular disease, causing mortality of 10 million people per year. Globally 30-40% patients are statin intolerant to pharmacological intervention owing to its side effects like kidney & liver failure, muscle weakness, diarrhea, memory loss, andcataracts. The causative factors include unhealthy foods & lifestyle, obesity, smoking, alcoholism, physical inactivity, and diabetes.

Objectives: To explore the most effective nutraceutical improving individual quantities of lipid profile. 2). To identify the highly significant nutraceuticals for the management of dyslipidemia.

Methods: Research design is review based meta-analysis involving 250 RCT studies, with 21,450 subjects, sampled through Prisma flow and PICO (Population, Intervention, Comparison, Outcome) being research instrument. Data collection & inclusion criteria were availability of complete article, human subjects, dosage, regime/day, treatment duration, and fasting lipid profile (TC, LDL, TG and HDL cholesterol) before and after treatment. Paired sample t-test and one-way ANOVA with 95% CI were used for inferential stats.

Results: The result demonstrated amongst 25 nutraceuticals, the most effective for improving individual quantities of lipid profile are Bergamot for TC reduction (p=0.003), Polyphenol reduced LDL (P=0.01), Spirulina reduced TG (p=0.004) & Niacin increased HDL (p=0.02). The highly significant nutraceuticals to treat overall dyslipidemia are (1). Niacin which reduced bad cholesterol (p=0.001) & increased HDL-C (p=0.02), (2) Dietary fiber reduced bad cholesterol (p=0.001) and increased HDL-C (p=0.005) and (3) Berberine reduced bad cholesterol (p=0.007) and increased HDL-C (p=0.05).

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusion: Nutraceuticals work best without side effects, accompanied with healthy diet, DASH diet for hospitalized CKD, diabetic, CVD in Statin intolerant. Bergamot, Polyphenol, Spirulina and Niacin significantly improved TC, TG, LDL and HDL-C, respectively. Niacin, Dietary fiber and Berberine are highly significant to manage dyslipidemia.

Keywords: Meta-Analysis, Nutraceuticals , Pico, Dyslipidemia, Lipid Profile

Conflict of Interest Disclosure: There is no conflict of interest between authors.

Further Collaborators: No

OAB(T7)4-7

Preventive effect of Sesaminol against Parkinson's disease by activation Nrf2-ARE signaling pathway

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Background and objectives: Parkinson's disease (PD) is a neurodegenerative disease caused by the degeneration of substantia nigra neurons due to oxidative stress. Sesaminol (3,4-methylenedioxy phenol) has strong antioxidant and anti-cancer effects. A method for purifying sesaminol from sesaminol glycoside was established recently. We investigated the preventive effect on PD as a new physiological action of sesaminol produced from sesaminol glycoside using *in vitro* and *in vivo* PD models.

Methods: To prepare an *in vitro* PD model, 6-hydroxydopamine (6-OHDA) was added to human neuroblastoma (SH-SY5Y cells). The neurotoxin rotenone was orally administered to mice to prepare an *in vivo* PD model.

Results: The viability of SH-SY5Y cells decreased dose-dependently following 6-OHDA treatment, but the addition of sesaminol restored viability to the control level. 6-OHDA increased intracellular reactive oxygen species production, and the addition of sesaminol significantly suppressed this increase. No Nrf2 expression in the nucleus was observed in the control group, but a slight increase was observed in the 6-OHDA group. The sesaminol group showed strong expression of Nrf2 in the cytoplasm and nucleus. NAD(P)H: quinone oxidoreductase (NQO1) activity was enhanced in the 6-OHDA group and further enhanced in the sesaminol group. The motor function of rotenone-treated mice was shorter than that of the control group, but a small amount of sesaminol restored it to the control level. The intestinal motility in the rotenone group was significantly lower than that in the control group, but it remained at the control level in the sesaminol group. The expression of α-synuclein in the substantia nigra increased in the rotenone group but decreased in the sesaminol group. The rotenone group exhibited shortening and damage to the colonic mucosa, but these abnormalities of the colonic mucosa were scarcely observed in the sesaminol group.

Conclusion: These results suggest that sesaminol has a preventative effect on PD.

Keywords: Sesaminol, SH-SY5Y cells, Nrf2-ARE signaling pathway, 6-Hydroxydopamine, Rotenone

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T7)4-8

Brown rice inhibits development of non-alcoholic fatty liver disease in obese Zucker (*fa/fa*) rats by increasing VLDL-secretion and lipid oxidation via activation of retinoic acid synthesis

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Background and objectives: White rice and its unrefined form, brown rice, contain numerous compounds that are beneficial to human health. However, the starch content of rice can contribute to obesity, a main risk factor for non-alcoholic fatty liver disease (NAFLD). Therefore, we investigated the effect of rice consumption on NAFLD and the underlying molecular mechanism.

Methods: Seven-week-old male obese Zucker (*fa/fa*) rats, an animal model of NAFLD, were randomly divided into three groups (n = 10 each) and fed one of three diets for 10 weeks: Cont (AIN-93G diet; 53% cornstarch), WR, (AIN-93G diet with cornstarch replaced with white rice powder) and BR (AIN-93G diet with cornstarch replaced with brown rice powder). Liver fat accumulation and gene expression related to lipid and vitamin A metabolism, including retinoic acid (RA) signaling, were analyzed.

Results: Hepatic lipid significantly decreased in the BR group compared with the Cont group by 0.4-fold ($P < 0.05$). The expression of genes related to hepatic fatty acid oxidation such as carnitine palmitoyltransferase 2 was approximately 2.1-fold higher in the BR group than the Cont group ($P < 0.05$). The expression of peroxisomal acyl-coenzyme A oxidase 1 and acyl-CoA dehydrogenase medium chain was also significantly increased, by 1.6-fold, in the BR group compared with the Cont group ($P < 0.05$). The expression of VLDL-secretion-related genes such as microsomal triglyceride transfer protein was also significantly higher in the BR group (2.4-fold) ($P < 0.05$). Furthermore, aldehyde dehydrogenase 1 family member A1, an RA synthase gene, was 2-fold higher in the BR group than the Cont group ($P < 0.05$). Conclusion: Brown rice prevented development of NAFLD in obese Zucker (*fa/fa*) rats via increasing the RA synthesis which therefore upregulated the fatty acid oxidation and VLDL secretion. These finding suggest a novel regulation mechanism of RA synthesis and the beneficial effect of brown rice on lifestyle related diseases.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: retinoid metabolism, NAFLD, lipid metabolism

OAB(T8)1-1

Blood urea nitrogen, creatinine, and kidney histopathology of rat during subchronic toxicity study of porang (*Amorphophallus oncophyllus*) flour macerated with *Strobilanthes crispus* in Wistar Rats

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Background and objective: Porang is local tuber that is widely cultivated in Indonesia. This tuber is high in beneficial compound glucomannan, but contain calcium oxalate that may damage the kidney. The maceration of *Strobilanthes crispus* could reduce calcium oxalate levels and proved to safe based on acute toxicity study. Subchronic toxicity test was important as the further study for its safety. This study aimed to investigate the blood urea nitrogen, creatinine, and kidney histopathology of rat after treated with porang (*Amorphophallus oncophyllus*) macerated with *Strobilanthes crispus* (PSC) during 28 days.

Methods: A sub chronic toxicity study was conducted based on The Regulation of The Head of The Food and Drug Supervisory Agency of The Republic of Indonesia. twenty-four male Wistar rats were divided into 4 groups, those were control (without oral administration), P1 (administered with 1000 mg/kg bodyweight/BW), P2 (2000 mg/kg of BW), P3 (4000 mg/kg of BW). Blood was collected from the vena retroorbital by microcapillary technic at day 0 and 28 after treatment for the measurement level of BUN and creatinine. At the end of the study, rats were euthanized by decapitation, the kidney organs were excised carefully, then preserved in 10% buffered formalin before the histopathological study.

Results: this study showed that the levels of BUN were normal after the 28 days of PSC administration (10-16 mg/dL) in all groups. Otherwise, the creatinine levels increased with the dosage increase of PSC administration. Kidney histopathological study confirmed that almost all of rats did not change, except for control, P1, and P2 groups that experienced to interstitial nephritis with the percentage of 40, 40, and 20%. This indicated that PSC did not damage the kidney.

Conclusion: The study concluded that PSC administration for 28 days did not change the normality of BUN and also did not damage the kidney. A further study must be conducted to know the deeper cause of creatinine increase.

Keywords: Amorphopahallus oncophyllus , Strobilanthes crispus, toxicity, blood urea nitrogen, creatinine

OAB(T8)1-2

Aspartame Consumption, Mitochondrial Dysfunction induced Impaired Oocyte Maturation, and Infertility Risk

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Background and objectives: Aspartame is the most popular non-nutritive sweeteners worldwide. No safety of consumption report has been studied regarding women of reproductive age who are preparing for pregnancy. We aimed to explore the harmfulness of aspartame and the potential mechanism by which it increases infertility risk through clinical observation, in vivo, and in vitro studies.

Methods: We established a cohort of 840 pregnant women, and retrospectively obtained their time to conceive. Animal models and a human granulosa-like tumor cell line (KGN) were used for investigating the possible mechanisms.

Results: Aspartame consumption is associated with increased infertility risk among younger women (OR:1.79, 95% CI: 1.00, 3.22). In vivo study revealed that aspartame provoked disturbed estrus cycle, lower anti-mullerian hormone level. Aspartame treatment also suppresses the antioxidant activities and result in higher oxidative stress in the ovary and granulosa cells. This is due to an aspartame-induced decline in mitochondrial function (maximal respiration, spare respiratory capacity, and ATP production capacity), and triggered mitochondrial biogenesis (assessed by energy depletion signaling-related factors SIRT1, pAMPK, PGC-1α, and NRF1 expression level). Aspartame may alter fertility by fewer reserve follicles in the ovary and poor steroidogenesis in granulosa cells.

Conclusions: In summary, these results demonstrated that aspartame consumption may increase infertility risk through mitochondrial dysfunction-induced impaired oocyte maturation. Hence, for women preparing pregnancy, aspartame are suggested to be used cautiously.

Keywords: Aspartame, Reproduction, Infertility, Mitochondria, ovary

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T8)1-3
Acrylamide: the carcinogen in your food

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Objectives: Acrylamide is a potentially cancer-causing substance that naturally forms in starchy food products during high-temperature cooking and low moisture, by Maillard reaction. European Food Safety Autority concluded that they cannot set a tolerable daily intake of acrylamide in food and estimated the dose range within which acrylamide is not a concern for publich health: 1 mcg of acrylamide a day. This dose may be found in 1 g of potato chips or 3 g of first born biscuits. Since potatoes and flours are one of the foods that contribute most to overall dietary human exposure of acrylamide, Chiara Manzi, together with Parma University and Cucina Evolution Academy, investigated the correlation between acrylamide content and color of these foods with the purpose to analyze the best cooking and processing method to reduce the exposure to acrylamide.

Methods: Acrylamide in foods has been detected by liquid chromatography coupled to mass spectrometry in baked potato samples cooked at different time, temperature and steam conditions. With the same tecnique was studied the formation of acrylamide in different types of doughs made respectively with 00 flour, wholemeal flour and a specifix mix of different cereals added in fiber, cooked at different temperatures, from 220 °C to 300 °C and with different timing, from 3 to 6 minutes.

Results: Acrylamide is directly proportional to the intensity of the color assumed after cooking. a Photographic Tool has been developed to help consumers recognize acrylamide in foods. Results showed that the darker the color of the potatoes, the more acryamide is present. A method of cooking potatoes very low in acrylamide has been developed: potatoes were cooked in oven (140°C – 180°C) for 10 to 60 minutes (steam/hot air). A special cereal mix for cooking Pizza very low in acrylamide has been developed and produced.

Conclusions: Daily we are exposed to acrylamide through the ingestion of many foods that contains this process contaminant. However, acrylamide is visible during food cooking and it is therefore essential to become aware of the excessive browning of foods. The best cooking processes for cooking pizza and potatoes have been investigated.

Keywords: Acrylamide, Culinary Nutrition

OAB(T8)1-4
Study on lactone formation by thermal oxidation of saturated fatty acids

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Background and objectives: Lactone is a important aromatic molecule that contributes to flavor in meat and dairy products. Although lactone is generally observed during thermal oxidation of saturated fatty acids, the generation mechanism has not been fully understood. In this study, four saturated triacylglycerols were thermally oxidized and their peroxide value (POV) and resulted lactones were analyzed to obtain the insights on this mechanism.

Methods: Four saturated triacylglycerols (trioctanoate (tri-C8), tridecanoate (tri-C10), tridodecanoate (tri-C12), and tritetradecanoate (tri-C14)) were used as samples. After oxidation under the conditions A (100-200°C, 60 min) and B (180°C, 0-480 min) (n = 5), the POV was measured. Lactones were analyzed by GC-MS.

Results and Discussion: Lactones were detected from all heated triacylglycerols and the carbon number of resulted lactones were mostly consistent with those of constituent fatty acid, i.e., tri-C8 > γ(δ)-octalactone, tri-C10 > γ(δ)-decalactone, tri-C12 > γ(δ)-dodecalactone, and tri-C14 > γ(δ)-tetradecalactone. The POV were 49.8 (tri-C8), 44.4 (tri-C10), 7.1 (tri-C12), and 10.1 (tri-C14) (meq/kg, 180°C, 120 min). These values were correlated with the amount of the generated lactones, which suggests that the formation of hydroperoxide is an important reaction for lactone generation. Lactones are generally known to be produced by dehydration cyclization of microbiologically generated hydroxy fatty acids. Additionally, the formation of saturated fatty acid hydroperoxide during heat treatment was shown by this study. Therefore, regarding the pathway of lactone formation by heat treatment of saturated fatty acids, we predict that hydroperoxyl groups may be formed at C4(C5), which are reduced to hydroxyl groups and cyclized to form γ(δ)-lactones.

Conclusions: This study suggests that hydroperoxyl group formation at C4(C5) is a key for the lactone generation on thermal oxidation of saturated fatty acids. In order to verify whether this mechanism is correct, we are now trying to isolate saturated fatty acid 4(5)-hydroperoxide. The insights obtained in this study is useful for the creation of certain lactones from saturated fatty acids, which will greatly contribute to the food industry.

Keywords: Lactone, Saturated fatty acid, Thermal oxidation, Hydroperoxide, Triacylglycerol

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T8)1-4

Assessment of purity and iodine content of sea salt in Visayas and Mindanao, Philippines

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Background and objectives: By law, salts sold in the Philippine market must contain at least 97% sodium chloride (NaCl) on a dry matter basis and 30-70 ppm (mg/kg) of iodine (I_2). However, salts may contain a variety of contaminants that are harmful to human health, particularly sea salts. Hence, this study aimed to assess the purity of sea salts produced in existing farms in the Visayas and Mindanao regions of the Philippines by determining their NaCl and I_2 contents.

Methods: Samples were collected from 15 sites for laboratory analyses. Sodium (Na) was determined using flame photometer method, chloride (Cl) by titrimetric method using silver nitrate (AgNO3), and iodine (I) by titrimetric method using sodium thiosulfate (Na2S2O3). The NaCl content of the collected sea salt was computed based on the molar mass of pure salt (39.3% Na and 60.7% Cl) with sodium being the limiting component.

Results: All the salt samples contained <97% NaCl (range: 67% - 94.6%) and <30 ppm iodine content (range: 1.7 - 13.4).

Conclusions: All the salts in the Visayas and Mindanao salt farms were not able to meet the required % of NaCl and level of iodine for Philippine market. These findings point to the necessity for initiatives to ensure that salts sold in the market meet the purity and iodization criteria for human consumption to ensure food safety and eliminate iodine deficiency disorder in the country. To properly analyze the composition and purity of salt in the Philippines, future research should investigate the heavy metal elements of both sea salts in addition to NaCl and I_2.

Keywords: salt, iodine, purity, NaCl, Philippines

Conflict of Interest Disclosure: None

Further Collaborators: This project is funded by Commission on Higher Education (CHED) Philippines

OAB(T8)1-6

Glutamate content in Thai and German condiments

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Background and Objective: Monosodium glutamate (MSG) is used as a flavor-enhancing additive. The negative effects of MSG at which level consumption are controversial. Objective of this study aims to determine the level of free glutamate content in Thai and German local markets.

Method: The glutamate levels were determined in 13 German and 14 Thai condiments, using Enzymatic Bio Analysis and spectrophotometry.

Results: The average glutamate content was higher in German condiments than that in Thai. Free MSG was found 8,416.67 mg/100 g in popular German condiment sauces and 226.00 mg/100 g in tomato ketchup, whereas found 2,533.33 mg/100 in Thai condiment sauces and fish sauce 741.67 mg/100 g. Tomato salad provide MSG 443.81 mg per serving which commonly consume in Germany, while in Thailand, red curry provide 113.33 mg MSG per serving.

Conclusions: This findings confirmed amount glutamate content in different German and Thai commercial condiments and seasonings. The MSG intake of two countries people depends on the product processing and food behaviors.

Keywords: Free glutamate, Condiment, Flavor enhancer, Cultural foods, Food habit

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: No further collaboration

OAB(T8)2-1

Fixing foodborne hazards in the value chains of nutritious foods to alleviate stunting: research in India, Indonesia and Senegal

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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Background and objectives: Nearly 162 million children under 5y are stunted worldwide. The Action Against Stunting Hub takes a holistic approach to understand and classify stunting, interdisciplinarily. One aspect is the potential of animal-source foods (ASFs) to prevent stunting, due to their high density in essential nutrients. However, ASFs can also generate foodborne disease, offsetting the benefits. Our objectives were to investigate foodborne hazards of select ASF value chains (VCs), to develop tailored market-based interventions that increase good quality ASF access by pregnant women and their infants, and ultimately alleviate stunting.

Methods: We conducted a systematic literature review to understand the stakeholder practices, the associated biological/chemical hazards and identify gaps and priorities for research in these VCs, in Hyderabad city (India), Lombok island (Indonesia) and Kaffrine county (Senegal), following the PRISMA-ScR approach. At each setting, a cohort of low-income pregnant women was recruited and followed up until their newborns were aged 2. Questionnaires, direct observation and food testing were conducted to identify consumer risk practices. We selected key ASFs for each cohort, based on consumption patterns and potential for upgrading and upscaling. Focus group discussions and key informant interviews were conducted to understand the consumer food environment and other VC aspects such as location of markets and retailers; input and output flows; production, processing and distribution channels, product and stakeholder characteristics; seasonality effects; perceptions in relation to food safety; or governance.

Results: Limited studies were available, but six ASF value chains were reported: dairy, poultry, pork, beef, fish and small ruminants. Key hazards identified were *Brucella spp*, *Campylobacter spp, E.coli, Salmonella spp,* and *Staphylococcus aureus* and Lead. The VCs identified as those with potential to alleviate stunting in the cohorts were egg, fish, and dairy. A conceptualisation map revealed important ASFs VC factors linked to stunting as production factors, infrastructure, governance and seasonality. Thematic analysis revealed the workings of the VCs, nodes where interventions can be targeted, and challenges to upgrading.

Conclusions: Addressing supply chain challenges, risks, and governance is feasible and this research aims to guide policy-makers on approaches to improve availability of nutritious and safe food among consumers.

Keywords: Stunting, Food safety, Animal-source foods, Value chains, Low- and middle-income countries

Conflict of Interest Disclosure: Not applicable

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OAB(T8)2-3

Evaluating the long-term effect of homestead food production on households in Darchula, Nepal: a mixed-methods assessment, eight years post-intervention

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Background and objectives: Despite significant progress over the last two decades of reducing stunting in Nepal, both maternal and child undernutrition remain major public health burdens. Agricultural interventions are known to be important for reducing malnutrition via improved production and consumption as well as income generation and women's empowerment pathways. Previous research studies have shown the effectiveness of homestead food production at improving diets and reducing anemia. No studies to date have assessed outcomes including dietary diversity, anemia, household food security, and wasting nearly a decade after the interventions, despite its importance for understanding the sustainability of improved outcomes. Suaahara, a large-scale, USAID-funded, multi-sectoral program (2011-2023) aims to reduce undernutrition among women and children in the first 1000-days of life via interventions in nutrition, health, family planning, agriculture, governance and gender and social equality. The primary objectives of this study are: 1) to evaluate the effect of the homestead food production (HFP) intervention at improving agricultural practices, household food security, and maternal and child dietary diversity more than eight years after the households received the HFP intervention and 2) to understand why, how, and when steps along the theory of change materialized or broke down.

Methods: The primary impact evaluation uses a quasi-experimental, repeated cross-sectional design with multi-stage clustering. An additional mixed methods endline survey to evaluate the homestead food production component is being done. In one remote mountain district (Darchula) that is part of the primary impact evaluation, about 80 randomly selected households were identified for whom we have baseline data and know when they received inputs (starting 2012-2013). During endline, these original households whose children are now 8 to 11 years of age will be followed as a cohort. Both quantitative and qualitative data will be collected in June-September 2022 by externally hired data collectors, overseen by an external principal investigator and research team. Ethics approval has been granted by the Nepal Health Research Council.

Results: Results will be available in the fall including primary impact estimates for agricultural practices, household food security, and maternal and child diets as well as primary qualitative findings.

Conclusions: The results will be used to guide future large-scale homestead food production efforts in Nepal and similar contexts.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Evaluation; Homestead Food Production; Nutrition Sensitive; Nepal, Undernutrition, Suaahara, food security, maternal and child diet, agriculture
Conflict of Interest Disclosure: NA
Further Collaborators: NA

OAB(T8)2-4

Role of home gardening on food security of rubber farmers in Iguoriaki farm settlement Edo state, Nigeria

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Food security is of great public health concern in Nigeria. This is due to the high rate of poverty in the country; it also impacts on the socio economic well being of the general populace, hence the need for the study. This study was conducted to access the role of home gardening on the food security of rubber farmers in Iguoriaki, Edo State, Southern Nigeria. Random sampling was used to select 50 respondents for the study. A well structured questionnaire was used to get information on the demographic characteristics of the respondents. Body Mass Index(BMI), Mid Upper Arm Circumference (MUAC), Dietary Diversity score and Home Gardening practices of the respondents were gotten. Result showed that the respondents do not eat fruits regularly, It also revealed 82% of the respondents had a BMI of 18.5- 24.9 which is within the normal range, while 12% of the respondents are overweight and 6% are obese(30.0-40.0) BMI. The study showed that 46% of the respondents are averagely food secured while 4%are very food insecured. 94% of the respondents own gardens and mostly plants vegetables. 49% of the respondents strongly agree that owning a garden makes them have more food for the family. 25% strongly agree it helps them to afford non food items, the result shows that 74% of the respondents earn less than 120 thousand naira monthly. 35.4% of the respondents also strongly agree that it affords them wider variety of food to eat. The result also shows that 2% of the respondents rear animals in their homes. 90% of the respondents get their primary source of water from borehole and 80% relies on their personal power generators as their primary source of energy. From the result, we see that owning a home garden has tremendous impact on the lives of the rubber farmers. A lot of extension work has to be done to enlighten farmers on the importance of owning a home garden.

Keywords: Food Security, Home Gardening, Rubber Farmers, Body Mass Index (BMI), Dietary Diversity Score
Conflict of Interest Disclosure: None
Further Collaborators: None

OAB(T8)2-6

Improving the nutritional value of recipes for women of childbearing age and children 6-23 months of age from *Vigna radiate* (l.) *Wilczek*. and *Moringa oleifera* in north-Benin

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Background and objectives: Enhancing biodiversity is a simple way to improve food choices and contribute to a diversified diet. This study aimed to improve the quality of foods consumed by women of childbearing age and children aged 6-23 months in the Atacora Department of northern Benin.

Methods: Two locally consumed recipes, *zankpiti* (a mixture of boiled cowpea with maize flour and red palm oil) and *abobo* (boiled cowpea with seasonings) were improved with mung bean (*Vigna radiata* (l.) Wilczek) and moringa leaves (*Moringa oleifera*). The formulation of the different improved recipes was done with Minitab software, version 18 using the mixing design. The optimized recipes were tested through a hedonic test by 62 volunteer couples in each of the three (03) study communes of Atacora. The real nutritional densities of accepted recipes were then determined.

Results: The results of the acceptability test showed that both recipes were well accepted by the mothers and their children. With regard to the real nutritional value, only the energy and vitamin A densities of the two recipes were well above the recommended standard (2.16 kcal/100g and 1084.99 RE ug/100kcal for zankpiti of mung bean (*ZM*); 1.85 Kcal/100g and 1009.75 RE ug/100kcal for abobo of mung bean with moringa leaves (*AMM*)). The nutritional densities of iron, calcium and zinc did not meet the recommended standards. Redarding the coverage rates of the daily children needs, both recipes had very high vitamin A coverage (828.99% and 618.39% for *ZM* and *AMM* respectively). Both recipes covered good levels of their zinc, iron and energy requirements (14.07% for zinc, 21.72% for iron and 34.53% for energy) while the AMM recipe covered a high level only for energy (28.33%). Regarding the daily calcium requirements of children, both recipes covered low levels.

Conclusions: *ZM* and *AMM* had good densities of energy and vitamin A and were well accepted by mothers and their children. However, although they were accepted, the nutrient densities of calcium, iron, and zinc in both recipes should be improved to allow for better coverage of children's daily nutritional needs.

Keywords: Biodiversity, formulation, nutritional value, Acceptability, Nutritional needs

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T8)3-1

Microbiota identification and their effects on characteristics of dry-aged beef manufactured in Japan

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Background and objectives: Dry aging is a traditional method of storing beef carcasses or cuts at refrigerated temperatures without vacuum packaging. Dry-aged beef (DAB) develops a crust including microflora with fungi and bacteria over the aging process. However, it is not well understood on DAB-related microorganisms and the changes in meat qualities caused by them during aging. Therefore, we aimed to determine the microbial distribution and their impact on DAB manufactured in Hokkaido, Japan.

Methods: Two blocks of rump obtained from the right and left sides of an individual Holstein steer were applied for dry or wet (vacuum-packaged) aging. Both portions were placed in a same aging room (2.9℃ and RH 90%) for 35 days, and the portion for dry-aging was allowed to contact with the fungal flora in the room air. After 35 days of aging, identification of fungal species and bacterial quantification on DAB crust were performed by DNA sequence and plate count method, respectively. Additionally, meat qualities such as water holding capacity, instrumental color and shear force were compared between DAB and wet-aged beef (WAB). Furthermore, free fatty acid composition and free amino acid content of DAB and WAB were measured by GC and amino acid analyzer, respectively. Volatile flavor compounds in the meat were prepared by HS-SPME and analyzed by GC-MS.

Results: The psychrophilic molds *Mucor flavus* and *Helicostylum pulchrum* mainly appeared on the crust of DAB, while lactic acid bacteria and coliforms were suppressed in the inner part of the meat. The meat quality, free amino acid and the composition of major fatty acids (C16:0, C18:0, and C18:1) did not differ between DAB and WAB. Dry aging suppressed acids and increased the production of various aroma compounds with mushroom-like, nutty, and other pleasant flavors.

Conclusion: In this study, we identified the furry molds that predominate on the crust of DAB as *M. flavus* and *H. pulchrum.* To our knowledge, this is the first time the combination of *M. flavus* and *H. pulchrum* has been reported on DAB. These results suggested that *M. flavus* and *H. pulchrum* may contribute to the production of unique flavors describing DAB.

Keywords: Dry-aged beef, microbiota, fungi, volatile aroma compound

Conflict of Interest Disclosure: Mr. Kenichi Tamura is a CEO of Kitaichi Meat Co., Ltd. This research was funded by Kitaichi Meat Co., Ltd. [grant number K20034].

OAB(T8)3-2

Preludes to standardize the preparation process of *nah poh*: Effect of emulsifying agent and crude palm oil types on the stability of emulsion

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Background and objectives: Producing emulsified traditional food products remains a problem to households and industries. Studies show that emulsion-based beverages are gaining consumer's attention. They are used as vehicle of bioactive compound, and very few exist on the market. In Cameroon there exist a gravy known as yellow *achu* soup or *nah poh*, that the preparation process is based on production of emulsion. When the emulsion is poorly prepared, it quickly destabilises. Due to the importance, we are interested to modernised it to make a commercial food product. In the present study, the effect of emulsifying agents (*kanwa*, burned *kanwa*, *niky*) and crude palm oil types were studied to understand the traditional knowledge related to the preparation of *nah poh*, to ease the intergenerational knowledge transfer necessary for its preparation and bring out a new food product.

Methods: A survey was conducted to collect knowledge related to the traditional practices used to produce more stable emulsion for the preparation of *nah poh*. Data collected were exploited to choose appropriate crude palm oil and to prepare emulsions. The stability of the emulsions was studied by the measurement of conductivity and apparent viscosity.

Results: It was found that there exist three main processes that are traditionally used for the preparation of the gravy. The apparent viscosity of crude palm oil emulsion produced using *kanwa* was higher 103cPthan that produced by *niky 28cP*. Emulsions produced with burned *kanwa* were shown to be more stable, with low variations of conductivity 9.4 to 10.25 mS/cm. Appropriate crude palm oils to produce more stable emulsions for *nah poh* were those with higher phospholipid content (10.33±3.96µg/100g and 9.72±0.93 µg/100g respectively). Oils having high saponification index were also good to produce more stable emulsion.

Conclusion: One can conclude that the stability of crude palm oil emulsion for *nah poh* depends on the phospholipid content, acid value the nature of emulsifying agent used as well as the process of preparation used.

Keywords: standardize, Nah poh, crude palm oil, emulsion, Stability

Conflict of Interest Disclosure: The authors deleare no conflict of interest

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OAB(T8)3-3

Effect of post-harvest handling processes on the nutrient, chemical composition and sensory properties of silver cyprinid powder.

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Background and Objectives: The proper post-harvest handling processing of the highly perishable silver cyprinid (Rastrineobola argentea) could contribute towards alleviation of food insecurity by directly acting as a food resource or employment for income generation among vulnerable groups. Despite the many processing techniques used, the quality and value of silver cyprinid still remains low. This research was carried out to establish how effective different post-harvest handling processes are in improving the quality (nutrient content, chemical and sensory properties) of silver cyprinid powder and objectives were to develop a process for the production of quality powder from silver cyprinid for utilization as an ingredient in human foods, to determine the effect of different postharvest processes on the nutrient and chemical composition of silver cyprinid powder.

Methodology: The silver cyprinid was subjected to different conditions: soaking in varying concentrations of NaCl (0.5%, 1%, and 1.5%), varying concentrations of acetic acid (0.05%, 0.1% and 0.15%), blanching at varying temperatures (40^{o}C, 50^{o}C, 60^{o}C) and sun-drying as control. Determined the proximate, chemical and sensory properties.

Results: Results showed that the different postharvest handling processes had significant effects on the proximate, chemical and sensory properties of the silver cyprinid powered. Increasing the NaCl concentration led decrease in proximate composition (Total ash, crude fat, moisture content and crude protein). Increase in NaCl also caused increase in chemical properties (pH and Thiobarbituric acid reactive substances (TBARS) of the silver cyprinid powder. Increasing acetic acid concentration caused variations in proximate composition; the moisture and ash content decreased while the protein and fat content increased. Increase in acetic acid concentration also led to a decrease in chemical properties, pH and TBARS. Increasing the blanching temperature on the other hand caused a decrease in all the proximate properties and pH but increased the thiobarbituric acid content. Soaking silver cyprinid in NaCl yielded sauces with higher consumer acceptability than those subjected to other treatments.

Conclusion: The study therefore revealed that treatment with 1% NaCl would be recommended to be used as preprocessing condition that maintains the nutrient and chemical quality of the fish and produces sauces with acceptable sensory characteristics .

Keywords: post-harvest , handling processes, silver cyprinid, food insecurity, nutrient and chemical composition

Conflict of Interest Disclosure: None
Further Collaborators: None

OAB(T8)3-4

Unleashing the health benefits of coloured potatoes

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Potato (*Solanum tuberosum*) is a beleaguered vegetable that has been blamed for the onset of ill-health such as diabetes and hypertension, because of its high calory contribution to the diet and its preponderance in junk food. However, it is a good source of protein and numerous nutrients (iron, phosphorus, and potassium). Nevertheless, inconsistent research outcomes on the role of potatoes in the diet have been obtained from observational and epidemiological studies, adding to the notorious reputation of elite potato varieties (characterised by having white/yellow skin and flesh). Revisiting heirloom varieties might uncover nutritional benefits of coloured potatoes, benefits which may have been lost during crop domestication. Anthocyanins are conspicuous plant pigments underpinning unique coloured potato varieties, and they are some of the best-characterised flavonoids derived from the phenylpropanoid pathway. To disentangle the interaction of phytochemicals and other bioactive components in the food matrix, I have analysed preselected heirloom coloured potato varieties including a standard white variety as a control, based on the similarity in the flavour of 10 pre-commercialisation germplasm varieties. In my preliminary study, anthocyanins were present in both raw red ("Red Emmalie") and purple ("Salad Blue")-fleshed potato tubers compared to the control ("Aura"). Cooking (steaming) affected the retention of anthocyanins in food. "Red Emmalie" has less colour loss during cooking than "Salad Blue." Metabolic analyses confirmed that pelargonidin was the main anthocyanin in "Red Emmalie" while petunidin was found in "Salad Blue". We hypothesized that anthocyanins might behave like proanthocyanidins (PAs) and improve the resistance of starch in potatoes. This was shown by Rapid Visco Analysis (RVA), which provided an indirect measurement of starch viscosity that mimicked the effects of cooking on starch. Our results indicated that starch granules could interact with anthocyanins *in vitro* and shifted the physicochemical properties of starch. In addition, PAHBAH assays were used to validate starch digestion over a time course, "Red Emmalie" was significantly more resistant to digestion compared to "Aura" and "Salad Blue" potato varieties. To gain further understanding of the interactions between starch and anthocyanins *in vitro*, we imaged potato starch granules in both uncooked and cooked potatoes using scanning electron microscopy (SEM). Uncooked starch had uniform oval spherical shape in all three varieties, however, there were smaller starch granules in "Red Emmalie" compared to "Salad Blue" and "Aura". This was also seen for starch granule distribution, measured using a coulter counter. However, the cooked starch was consistently broken into pieces in all three varieties. In addition, confocal image analysis elegantly demonstrated the localization of starch granules and anthocyanins in cross-sections of the three potato varieties. Anthocyanin Vacuolar Inclusions (AVI) were found in "Red Emmalie". Overall, this study holds the promise that coloured potatoes offer the potential for addressing the interactions

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

between anthocyanins and the resistance of starch to digestion. They may also demonstrate that coloured potatoes release the calories from their starch more slowly and so may offer health benefits to the consumer relative to standard white potatoes.

Keywords: Anthocyanin , Colored potatoes
Conflict of Interest Disclosure: No
Further Collaborators: No

OAB(T8)3-5

Effect of exogenous enzyme on the utilisation of dried cashew apple pulp in broiler chicken diets

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Background and objectives: Cashew apple is hugely wasted in cashew producing countries with less than 10% used in immediate consumption as fruit, alcoholic and non-alcoholic beverage production. This is due to its quick deterioration after harvest. Sun drying cashew apple and its inclusion in poultry feeds is a novel practice which could enhance income for cashew producers and lower cost of production of poultry meat and eggs. However, dry cashew apple pulp (DCAP) has a considerable fibre content which could limit its utilisation in chickens. Exogenous enzymes have been used to improve feed for chickens. This experiment was therefore carried out to study the effect of a multienzyme in the utilisation of DCAP in broiler chickens.

Methods: A total of 288 unsexed Arbor Acre Plus broiler chicks were randomly allotted to six treatments and replicated six times in a 2x3 factorial arrangement in a completely randomized design. There were eight birds per replicate. Six diets each were formulated for starter and finisher phase, three levels of 0%, 15% and 30% DCAP replacement for maize with and without enzymes. The enzyme used was a multienzyme named NATUZYME and contained amylase α-amylase (400,000Ukg^{1}) from *Bacillus subtillis,* β-glucanase (700,000 Bioproton bukg^{1}) from *Trichoderma longibrachiatum*, phytase (1,300,000ukg^{-1}) *Aspergillus niger*, cellulase (6,000,000 Bioproton cukg^{-1}) from *Trichoderma longibrachiatum* , xylanase (10,000,000Bioproton xukg^{-1}) from *Trichoderma longibrachiatum* and protease (700,000Ukg^{-1}). Parameters taken were feed intake, weight gain, feed conversion ratio, digestibility and cost analysis.

Results: There was no significant difference in feed intake. Weight gain was higher in 30% DCAP with enzyme at the starter phase. Enzyme did not have any effect on weight gain at the finisher phase. No significant difference was observed in feed conversion ratio. At 30% DCAP replacement for maize; crude protein, ash, crude fibre, ether extract and nitrogen free extract digestibilities were improved but not dry matter digestibility. There was no significant difference in the cost of feed consumed/weight gain in DCAP replacement for maize.

Conclusions: The multienzyme used conferred benefit to the partial replacement of maize with DCAP only at the starter phase.

Keywords: Alternative ingredient, Dry cashew apple pulp, Exogenous enzyme, Maize, Broiler chicken
Conflict of Interest Disclosure: No conflict of interest

OAB(T8)4-1

Changing directions of agricultural land use in the face of global climate change - the case of Central Europe

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Background and objectives: Agricultural land, as no other form of human economic activity, is dependent on climate and weather phenomena. Each, the smallest climate change or weather anomaly causes serious effects on land management, such as the change of the area of its components and the range of agricultural crops, the modification of the timing of field works, the change of yields. Recognition of relations between global climatic phenomena and agricultural land use is very important for forecasting possible changes and modeling adaptive forms within land management, in the aspect of biodiversity of ecosystems and food security. The aim of this paper is to assess the production possibilities of agriculture in Central Europe in the face of the challenges of climate change, with a focus on adaptation measures in agricultural land use.

Methods: The research used a variety of techniques from the field of analysis of found materials, statistics and spatial analysis, and cartographic methods of presentation. Using statistical methods to examine time-series data, trends in agricultural land management under the influence of climatic factors over the past several decades were determined. Trends in social and economic change were contrasted with trends in changes in climatic factors. This allowed the identification and evaluation of the role of individual climate elements in the agricultural economy. As a result, it was possible to develop characteristics of climate-agriculture interactions.

Results and Conclusions: Climate warming in the coming decades is the most likely phenomenon, confirmed by numerous scientific studies. In agriculture it will bring a spatial polarization of food production. In Central Europe, as a result of increasing temperature and lengthening of the growing season, the production potential will increase, resulting in the introduction of new plant crops and a shift in their range limits towards the north. It can be assumed that there will be rather favourable changes in terms of agricultural production possibilities, although significant areas are increasingly affected by extreme weather events. In Poland, the assumed climatic changes may bring about an increase in production potential, due to the lengthening of the growing season and the possibility of growing thermophilic crops. With optimistic assumptions it will be possible to graze grassland animals all year round. In case of

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

some crops it will be possible to obtain two harvests. Improvement of fodder resources will result from the possibility of growing pre-crops and catch crops. However, it is necessary to take into account the possibility of more frequent extreme weather phenomena, which may reduce the potential for production growth.

Keywords: land use, climate change, agriculture, Europe, food production

Conflict of Interest Disclosure: No

Further Collaborators: Not applicable

OAB(T8)4-2

Multiplying the efficiency and impact of biofortification through metabolic engineering of rice for the Philippines

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Background and Objectives: Recently the Philippine government has approved commercial production of transgenic rice with provitamin A in the milled grains (Golden Rice). Soon analogous approvals will be sought for transgenic high iron and zinc rice. What contribution might transgenic provitamin A, iron, and zinc rice make to intakes of these three key nutrients in Philippine diets?

Methods: Transgenic lines with high densities of provitamin A, iron, and zinc were grown alongside popular conventionally bred varieties. Levels of provitamin A, iron, and zinc were measured after 10 percent milling. Iron and zinc were measured using ICP analysis. Total carotenoids were measured using a spectrophotometer after two months of storage to take account of degradation.The average daily per capita intake of milled rice (300 grams) was applied to these differentials to estimate the increment for any given day where the transgenic rice substitutes completely for conventionally-bred rice.

Results: Each gram of transgenic rice provides +1 RAE whereas there is no provitamin A in ordinary milled rice, and increments of +31.6 mg/kg of Zn, and +7.8 mg/kg of Fe. At a daily intake of 300 grams this provides 300 RAE before cooking, and an extra 10.5 mg Zn and 2.3 mg Fe to average intake. Current intakes are approximately 500 RAE (before cooking) and 9 mg Fe. Further research is being undertaken to estimate zinc intakes in the Philippines from all foods and to disaggregate the analysis by urban/rural, wealth quintile, and age/gender. Rice intakes do not vary significantly by income group, but mineral and vitamin intakes are significantly lower in lower wealth quintiles.

Conclusions: Transgenic rice with provitamin A, zinc, and iron, holds great potential for increasing the daily intakes of these three important nutrients in the Philippines. The key challenge will be to secure wide adoption. Iron and zinc are tasteless and invisible whereas provitamin A gives the milled grains and cooked rice a yellow color which marks the nutritious product. Because of high yields, in equilibrium the transgenic rice should sell for the same price as conventionally-bred rice.

Keywords: Micronutrients, Provitamin A, Iron, Zinc, Biofortification

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OAB(T8)4-3

Use of orange-fleshed sweet-potato (*Ipomoea batatas* L.) for the prevention of vitamin A deficiency: the successful experience of Kaffrine, Senegal

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Background and Objectives: The orange-fleshed sweetpotato (OFSP) is interesting for nutrition as it contains a high level of β-carotene, source of vitamin A. However, the agronomic performance and their nutritional composition may vary according to agro-ecological areas and production practices. The aim of this study was to implement the OFSP production in the agroecological conditions of the Groundnut Basin for the prevention of vitamin A deficiency.

Methods: Assessment of the agronomic performance and nutritional composition (proteins, carbohydrates, lipids and β-carotene) of two OFSP varieties (Kandee and Caromex) was conducted during two growing seasons. An acceptability test of the selected OFSP variety was carried out and the effect of regular consumption of OFSP on the plasma concentration of β-carotene was evaluated by a randomized trial study in children 12–23-month-old during 15 days consumption.

Results: In the experiments, the yield of marketable tubers obtained was comparable between varieties and was 21.5, 22.5 t ha^{-1} for Kandee, Caromex respectively. Kandee was the variety with the highest in β-carotene content (101.1 mg/kg; P<0.001). The amount of dry matter of the varieties was correlated with the yield of marketable roots (r=0.54; P=0.04) and the carbohydrates content (r=0.52; P=0.05). The puree of the Kandee variety was accepted by the children and the amount served (50 g) contained 2761.9 µg of β-carotene and covered 25.3% of the vitamin A requirement of children. The consumption of Kandee during the 15 days maintained the β-carotene concentrations of the children in the test group compared to the control group whose β-carotene

concentrations decreased significantly (0.27 µmol/L vs. 0.21 µmol/L; p <0.001) after 15days consumption.

Conclusion: OFSP production has been successful in the agro-ecological zone of the groundnut basin of Senegal with agronomic acceptable performance. The difference observed between these varieties lies in the nutritional composition, particularly in the β-carotene content. The Kandee variety, accepted by children constitute a sustainable solution for the prevention of vitamin A deficiency in rural area.

Keywords: Orange-fleshed sweetpotato, Agronomy, β-carotene, Vitamin A deficiency, Senegal

Conflict of Interest Disclosure: The authors have not declared any conflict of interests

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OAB(T8)4-4

Organic food market in Romania. potential and trends

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Background and objectives: Organic production, based on the circular economy and carbon sequestration in the soil, could be profitable for local farmers. The paper aims to highlight the most relevant characteristics of the organic food market in Romania.

Methods: Clarivate Analytics, SCOPUS and ResearchGate were used for documentation. The information was collected from the databases of the NIS, MARD, Eurostat. Data were statistically processed, represented and analysed.

Results: The research showed that in Romania the organically area represents about 3% of the total agricultural area used, well below the European average. The organic area has grown steadily in recent years, being favoured by access to technical information. Organic cereals and industrial crops are the most important, green harvested plants have grown impressively in recent years (by over 40%), while the areas cultivated with permanent crops of vineyards, fruit trees and nuts have exceeded 10,000 hectares. The evolution of ecologically certified livestock is characterized by a decrease in the number of sheep and pigs, constant values in cattle and significant increases in poultry and bees. Over 80% of organic food products consumed in Romania are imported. The Romanian organic agriculture is based on exports, farmers taking advantage of high prices on foreign markets, the trend being accentuated by the lack of processing facilities on the domestic market. Organic food stores are not very widespread in Romania, while the large chains of food retail stores have developed separate sections for organic food, offering a wider variety. Food retailers strive to present organic products as affordable, to encourage customers to buy organic products, the price being perceived as the main barrier to consumption in Romania.

Conclusions: There is a slight tendency to increase the consumption of organic food, with effects in the food service sector as well. The organic food market in Romania is still in an early stage of development compared to the western ones, but it is connected to the European trends, having a significant potential for growth in the future.

Keywords: Organic, Food market, Romania

Conflict of Interest Disclosure: No

Further Collaborators: No

OAB(T8)4-5

Evaluation of pesticide residue and nutritional profile of selected raw foodstuff from three different markets in Ibadan, Nigeria

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Background and objectives: Regulation of storage and methods of preservation of raw foodstuffs in local markets are not uniformly enforced in Nigeria, this has led to variations in market practise and abuse of pesticides and use of unapproved pesticides in food storage. There is a paucity of information on the effect of these irregular practices on the nutritional status and safe consumption of raw food materials without pesticide residues. This research was designed to evaluate the nutritional profile, and pesticide residues in selected raw foodstuff from three different markets in Ibadan, Nigeria.

Methods: Five raw foodstuffs (maize, yam, sweet potato, rice, and cassava grit) purchased from three markets (Eleyele, Gbaremu and Sango) were subjected to chemical assay for (%) determination of proximate composition and pesticide residues using standard procedures. Experimental design was a 3 × 5 factorial arrangement in a completely randomized design. Data were analysed using ANOVA and means were separated at $\alpha_{0.05}$

Results: There were variations in proximate parameters based on market location. Samples from Sango market had the highest mean value for Dry Matter (DM) (62.50±32.08) and Crude Fat (CF) (1.36±1.38), samples from Eleyele market had the highest content of Crude protein (CP), Crude fibre and Ash (5.62±3.11, 1.68±0.72, 3.11±0.93) respectively, while the highest Carbohydrate content (2.44±1.27) was recorded in samples from Gbaremu market. Similar values were recorded for Bifenthrin residues in the samples from all the markets. Samples from Gbaremu market (maize, rice, and yam) contained the highest amounts of Bifenthrin residues compared with other markets. Maize was found to contain the highest mean value of Bifenthrin residues (0.007±0.0002) while potatoes had the least amount of Bifenthrin residues (0.002±0.0005).

Conclusions: Pesticide residues (Bifenthrin) were found in every sample evaluated. This may be due to poor market handling and misuse of pesticides. There is therefore a need for regulation and enforcement on market storage and preservation practices to enhance food safety in Nigeria.

Keywords: food safety, pesticide residue, nutrient profile, Storage, Foodstuff

Conflict of Interest Disclosure: There are no conflict of interest to disclose on this work.

Further Collaborators: None

OAB(T9)1-1

Correction of iron deficiency anemia improves vaccine response to the ChAdOx Covid-19 vaccine in young Kenyan women

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Background and objectives: Increasing immunization efficacy and reducing anemia are key global health goals. Vaccines often underperform in low- and middle-income countries. Iron deficiency anemia (IDA) may impair adaptive immunity. Whether IDA impairs vaccine response and whether iron repletion before vaccination improves response is uncertain. Our aim was to compare vaccine response in IDA women receiving iron treatment or no iron treatment before vaccination.

Methods: 121 women were included into this randomized, open-label, controlled intervention trial. The treatment group (n=61) received intravenous iron (1000mg) 7d before vaccination. The control group (n=60) received no treatment. All women received the first dose of the Oxford-AstraZeneca ChAdOx Covid-19 vaccine. Vaccine response was measured at 28d. Previously to COVID-19 exposed women were excluded from the analyses. Cut-offs of 264 and 506 BAU/ml were used for anti-spike and anti-RBD to define seroprotection.

Results: Overall median (IQR) age was 35 (24-43) years. Median (IQR) hemoglobin (Hb) and plasma ferritin (PF) was 10.3 (9.1-10.8)g/dl and 8 (5-17)µg/L at baseline and increased to 11.3 (10.2-11.7)g/dl and 741 (506-891)µg/L at time of vaccination in the treatment group. In the control group, median (IQR) Hb and PF were 10.1 (9.4-11.0)g/dl and 7 (6-13)µg/L at time of vaccination. Median (IQR) COVID-19 anti-spike and anti-RBD antibodies were 2.52 (2.04-3.10), 4.45 (3.07-8.63) and 2.33 (1.87-3.25), 3.41 (2.61-6.92)BAU/ml in the treatment and control groups at baseline. At 28d after vaccination, anti-spike and anti-RBD antibodies were significantly higher in the treatment group with median (IQR) 66.52 (28.95-278.20), 38.01 (18.03-171.73) and 53.97 (21.47-135.18), 30.00 (14.62-75.86)BAU/ml ($p<0.05$ for both). None of the women were seroprotected at baseline. At 28d after vaccination, 26.7% had seroprotective anti-spike antibody concentrations in the treatment group compared to only 3.4% in the control group ($p=0.010$).

Conclusion: Iron treatment improved vaccine response to the ChAdOx Covid-19 vaccine in IDA women: antibody concentrations and seroconversion were significantly higher in the treatment group at 28d after vaccination. Because ID is so common and the vaccine-preventable COVID-19 disease burden so high, even if IDA only modestly reduces immunogenicity, its prevention could have major benefits. These findings suggest iron nutrition may be a determinant of vaccine response.

Keywords: Iron deficiency anemia, Iron nutrition, Covid-19 vaccine, Immunity, Vaccine response

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OAB(T9)1-2

Assessing the use of different anthropometric indicators for acute malnutrition surveillance: results from a multi-country study

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Background and objectives: Surveillance with anthropometric indicators is crucial for detecting any deterioration in the nutritional status of a population, prioritising interventions and allocation of resources as well as monitoring their impacts. Consequently, it is essential that the indicators used for monitoring yield comparable results. We aimed to compare the results using different indicators across countries in Sub-Saharan Africa and Yemen in the Middle East.

Methods: We calculated the prevalence of acute malnutrition measured by weight for height z score below -2 (WHZ2), middle-upper arm circumference below 125 mm (MUAC125) and middle-upper arm circumference z score below -2 (MUACZ2) in a sample of 682 283 children from 27 countries. We compared the resulting prevalences at global, regional and country levels and stratified the results by age, gender, and stunting status.

Results: In this large sample, the prevalence of acute malnutrition is consistently higher among younger children for MUAC125 and WHZ2, and higher among children for MUACZ2. The prevalence of acute malnutrition is higher among girls when using MUAC125 but higher among boys when using WHZ2 or MUACZ2, and it is consistently higher among stunted children independently of the indicator used.

Conclusions: The prevalence of acute malnutrition in a population varies depending on the indicator used to diagnose, and sampling characteristics in terms of age, gender and stunting status of the children. Thus, for monitoring purposes it is key to report the indicator used for acute malnutrition identification and to provide results stratified by sex, age group, and stunting status.

Keywords: acute malnutrition, weight for height, MUAC, surveillance

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

OAB(T9)1-3

Harmonizing the process for establishing recommended nutrient intake values.

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Background and objectives: In 2005, King and Garza proposed a process for deriving recommended nutrient intakes (RNIs) with the goal to improve the objectivity and transparency of the process for deriving the values; to provide a common basis across countries and regions for establishing consistent public and clinical health objectives and food and nutrition policies, and for addressing trade and regulatory issues.

Methods: In response to this charge, the U.S. National Academies, the World Health Organization, and the United Nation's Food and Agriculture Organization held an international workshop to create a dialog among potential stakeholders for exchanging ideas about ways to achieve the goal of harmonization. Subsequently the U.S. National Academies convened a consensus study with the goal of recommending a framework for deriving RNIs and using case scenarios to demonstrate how the framework could be applied to populations of interest.

Results: An outcome of both the workshop and consensus study was a derivative communication product: a tool kit that built on the discussions of the 2017 workshop and recommendations from the consensus study, as well as current information relevant to the process of establishing RNIs. The tool kit is designed to facilitate the process of deriving core RNIs for all global stakeholders, particularly for those in low- and middle-income countries. It is also intended to serve as a next step in moving forward toward a globally harmonized process for deriving the core RNIs.

Conclusions: Implementing the guidance offered in the tool kit will facilitate the harmonization process by laying the groundwork for developing a plan that builds on the experience, expertise, tools, and resources needed to achieve the harmonization goal. Moving forward will require regional and international working groups and partnerships; leadership in establishing regional and international approaches to harmonization; and support for the model and its importance to national and international audiences.

Keywords: harmonization, reference values, nutrition policy, recommended nutrient intakes

Conflict of Interest Disclosure: The authors have no conflicts of interest to declare.

OAB(T9)1-4

No wonder everyone is confused - food guidance systems are not always consistent with dietary guidelines

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Background and objectives: Food guidance systems aim to promote 'healthy' food choices to consumers. National dietary guidelines, based on a significant breadth of evidence, promote foods such as fruits, vegetables and whole grains in public health messaging. National food regulatory agencies provide guidance on health claims on foods and often regulate nutrient profiling systems aimed to guide consumers towards healthier choices. Recently, a body of research has encouraged consideration of the role of consumption of highly processed foods in development of chronic disease (NOVA food classification system). Given the number of varied food categorisation systems available, the current study aimed to determine which food groups or types of foods show the greatest disparity between categorisation systems, to aid the development of a universal system to provide consistent consumer guidance.

Methods: We considered all foods in the 2011-2013 Australian Food, Nutrient and Supplement Database, categorising foods according to the following systems: Health Star Rating (Australian front-of-pack nutrient profiling system), NOVA (differentiating based on minimally- to ultra-processed), application of the Whole Grain Initiative's new whole-grain food definition, and the Australian Nutrient Profiling Scoring Criterion which determines if foods are able to make a health claim on front-of-pack.

Results: Grain products, even those considered core foods and encouraged in health promotion guidelines show particular disparity across classification systems. Nutrient profiling systems in Australia do not include whole grain and therefore may provide inconsistent messaging compared to dietary guidelines which specifically promote whole grain. The NOVA system classifies a majority of whole-grain products (breads and ready-to-eat breakfast cereals) as ultra-processed which means messaging based on NOVA is contrary to dietary guidelines. In addition, discouraging intake of some foods in the current food supply would limit fortified foods which have successfully improved intake of nutrients such as iodine, thiamine and folic acid.

Conclusions: Further analysis of outcomes associated with specific dietary patterns, which consider multiple elements of foods (such as not only nutrients or only processing) are required to ensure consistent dietary messaging to reduce consumer scepticism.

Keywords: Dietary Guidelines, whole grain, nutrient profiling, ultra-processed foods

Conflict of Interest Disclosure: No funding was received for this work. In the past, EJB has been paid to present research findings by General Mills and research funding from Cereal Partners Worldwide.

OAB(T9)1-5

Contesting the future of red and processed meat in healthy and sustainable food systems: how food system actors frame the problem.

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Background and objectives: Reports from international organisations and experts groups call for reductions in production and consumption of red and processed meat (RPM) (in high-income countries in particular) to attenuate associated health and environmental harms. Policymakers have given limited attention to the issue and public discourse is contentious. Framing of RPM as a policy issue by influential actors may be contributing to inertia and confusion. This project investigates the global political challenge of meat reduction by comparing beliefs and worldviews represented in news media and from food system stakeholders.

Methods: Drawing from findings of a media analysis and key informant interviews with 30 stakeholders, this study uses a framing analysis design, using news media sources and key informant interviews analysis to address the aims. Individuals with knowledge and expertise in, or interest in, red and processed meat with relation to; global public health and nutrition policy and/or environmental sustainability OR commercial interests were considered eligible participants for the study.

Results: 150 news media articles were analysed, and 30 participants were interviewed – spanning academia, civil society, intergovernmental organisations, and industry. Meat reduction as a concept in news media was polarising, with industry framing it as part of the 'vegan agenda'. Many interest groups attempted to discredit the reports, citing lacking evidence or conflation of production methods. In contrast, whilst stakeholders perceived the concept to be publicly polarising, there was convergence across all groups on the value of RPM in a healthy and sustainable diet. Many participants cited a lack of nuance in public discourse, with framing on harms and benefits of RPM being over-simplified. Some participants noted that intensive meat production and high consumption levels reflected corporatized/globalised supply chains, and power relations were the most critical factor to address the harms of RPM. Participants also viewed the preference for technology-driven responses (i.e., novel proteins) as reinforcing corporate power in the food system.

Conclusion: This study shows that despite polarised public discourse, more convergence on the issue across food systems stakeholders exists. Furthermore, powerful actors such as the meat and 'novel protein' industries are perceived to be a driving influence in maintaining the market-driven status-quo and are a likely obstacle in achieving healthy and sustainable consumption of RPM.

Keywords: Red meat, Processed meat, Sustainable food systems, Politics of food

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

Further Collaborators: N/A

OAB(T9)2-1

WHO Nutrient and Promotion Profile Model (NPPM) for ensuring appropriate composition and marketing of food products for infants and children under 3 years of age in the WHO European Region

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Background and objectives: Many commercial food products for infants and young children (FIYC) are inappropriate, exposing this vulnerable group to foods that disregard public health recommendations. Concerns with FIYC are seldom tackled by legislation and include: i) high sugar contents, sweet tastes and free sugar use; ii) marketing from 4 months of age, despite WHO guidance to exclusively breastfeed to 6 months; iii) pervasive use of nutrient, health and marketing claims. The NPPM aims to support countries identify inappropriate FIYC, engage with stakeholders to raise awareness, and effect policy and legislative change to support optimum nutrition and reduce NCD risk in later life.

Methods: The NPPM was developed through an iterative process, accounting for strengths and weaknesses in existing legislation, assessment of documented issues with modern FIYC, a 10-country product evaluation against NPPM requirements, discussion within an expert meeting and through direct consultation with countries. A user-friendly NPPM with an implementation toolkit has been developed by WHO. Application will be supported by an online product assessment tool to rapidly examine acceptable or inappropriate nutritional and promotional features of FIYC.

Results: The NPPM categorises products and sets appropriate nutritional and promotional requirements. To address high sugar exposure, products should not contain free sugars (including fruit juice), meals and snacks should have limited sugar/fruit content, and inherently sweet foods (e.g. fruit puree) should have a clear 'high sugar' indicator on packs. NPPM thresholds also specify energy density, sodium, protein, and total fat contents. No products should be marketed as suitable before 6 months of age, and the NPPM restricts use of marketing claims. The NPPM implementation toolkit will help generate and tailor impact on national policy and legislation through providing guidance on i) stakeholder mapping; ii) working with government/policy audiences; iii) engaging industry; iv) product evaluation; v) illustrative case studies.

Conclusions: The NPPM and toolkit can elevate awareness and support engagement across different key stakeholders to

ensure appropriate sale of FIYC. However, strong political leadership and proactive industry engagement are essential to lead the way in safeguarding vulnerable groups (new parents and infants/children) from overbearing promotional messaging and/or products with unsuitable composition.

Keywords: Nutrient Profile Model, Policy, Babyfood, Complementary feeding, Marketing

Conflict of Interest Disclosure: Janet Cade is the company director of Dietary Assessment Ltd. a University of Leeds spin-out company

OAB(T9)2-2

Understanding the cost implications of nutrition data collection: Lessons from Nigeria

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Background and objectives: In 2014 the Global Nutrition Report called for a "nutrition data revolution." Since then, there have been increasing calls for more and better nutrition-related data. Collecting these data points, however, comes with additional costs. To explore the cost considerations of collecting nutrition data, we identified potential issues of adding or removing nutrition indicators in five existing data platforms in Nigeria to inform recommendations for improved coordination of national nutrition data collection by Nigeria's Federal Ministry of Health.

Methods: We reviewed publicly available information and consulted with 32 global and Nigerian nutrition data experts to identify cost drivers for five data collection platforms in Nigeria: Demographic and Health Survey, Multiple Indicator Cluster Survey, National Nutrition and Health Survey, Food Consumption and Micronutrient Survey, and Health Management Information System.

Results: Three findings emerge from this study. *First*, adding or removing a nutrition indicator can have significant cost implications across all phases of indicator development, from planning and data collection to analysis and dissemination. *Second*, the extent to which costs are affected in each of these phases varies by the feature of the platform and indicator complexity. Examples of key cost drivers include whether a global questionnaire needs to be adapted to the country context or an indicator reflects a new topic area and requires skills development for data collectors. *Finally,* the additional costs incurred are both monetary and non-monetary. For example, adding questions to a survey can impact data quality through "survey fatigue".

Conclusions: To our knowledge, this is one of the first studies to examine cost considerations when deciding whether and how to collect nutrition indicators. Stakeholders at the country level involved in planning and financing nutrition data collection should consider their data needs against data availability and cost implications to determine the frequency and mode of data collection. Financing strategies should be included in planning stages to ensure adequate resources exist to collect the necessary data while maintaining data quality. This is especially important for nutrition indicators included in multi-topic surveys with competing content and funding priorities.

Keywords: Nutrition indicators, Nutrition data, Nutrition costs, Nutrition household surveys

Conflict of Interest Disclosure: No competing interests were disclosed.

Further Collaborators: This study would not have been possible without the outstanding work of Mashin Muhammad and Oluwapelumi Adeyera who served as data collectors in Abuja, Nigeria. We would also like to thank Rebecca Heidkamp and Elyse Iruhiriye from Johns Hopkins Bloomberg School of Public Health for their feedback.

OAB(T9)2-3

A novel analytical framework for identifying and exploring public health pathways linking COVID-19 with nutrition outcomes developed by the Agile Core Team for Nutrition Monitoring (ACT-NM)

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Background and objectives: ACT-NM was established in June 2020 by UNICEF, USAID, WHO and USAID Advancing Nutrition to jointly consider nutrition monitoring issues during the COVID-19 pandemic. The team prioritized the development of a comprehensive analytical framework focused on public health pathways linking COVID-19 to nutrition outcomes using the six global targets for maternal, infant and young children nutrition endorsed by the World Health Assembly.

Methods: The development of the analytical framework was done in three interconnected phases: 1) conceptualization; 2) literature review; and 3) design. The conceptualization process identified the critical issues for a framework focusing on the factors and pathways connecting COVID-19 and nutrition outcomes. This process was supported by a pragmatic literature review, which identified 21 existing frameworks/models with structures and/or content relevant to COVID-19 and nutrition. The analysis of the 21 frameworks/models provided multiple insights applicable to the design of a single, comprehensive analytical framework able to capture critical public-health pathways.

Results: The ACT-NM framework is built around five categories of factors directly relevant to the intersection of

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

COVID-19 and nutrition: 1) enabling determinants, or context; 2) underlying determinants, as they relate to food, health, social protection, education and WASH systems; 3) immediate determinants, including behaviors and nutritional status; 4) outcomes; and 5) impact. In turn, the various sub-categories include a range of salient factors, from travel restrictions to access to nutrition services. The framework's left-to-right axis enables users to identify and explore numerous public health pathways. The framework also acknowledges the overall environmental context and the wide-ranging effects of COVID-19 on the five categories. In addition, the framework recognizes the causes and consequences of deepening inequality due to the pandemic.

Conclusions: The ACT-NM framework is a dynamic and visual tool to plot a wide range of proven and potential pathways connecting multiple determinants and factors with nutrition outcomes and impacts. The versatility of the framework makes it applicable in diverse settings, enabling users to look at COVID-19-nutrition pathways from different perspectives, with different priorities and at different levels. In addition, elements can be added to the framework to address new shocks and evolving circumstances.

Keywords: COVID-19, Nutrition, Framework, Pathways, Outcomes

OAB(T9)2-4

Ongoing challenges in food security among Asia Pacific since COVID-19 pandemic

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Objective: Asia-Pacific region is more vulnerable to shocks in food supply and demand. Global attention is required to understand the situation and deal with the problem through continuous monitoring since the COVID-19 pandemic. This study examined the changes in reported livelihood activities and weekly income among poor Asian populations between pre-pandemic and mid-2021 and the time-trend in food security status from mid-2020 to 2021.

Methods: We used survey data collected among World Vision supported communities in Cambodia (n=621), India (n=797), Indonesia (n=951), Sri Lanka (n=684), Laos (n=717), Myanmar (n=678), Nepal (n=602), and Vietnam (n=3,578). Changes in income-generating activities prior to COVID-19 and at the time of the survey (mid-2021) were tested for equality of proportions of each activity. Relative weekly income change, income and job loss since COVID-19, and type of benefits between was compared between rural and urban areas using a paired student t-test or chi-square test. Food security status (food stock availability at households, availability of essential items at markets, and affordability of essential items) were tested for the change between 2020 and 2021 using logistic regression analysis in India, Indonesia, Myanmar, and Vietnam.

Results: By mid-2021, household economic status and livelihood activities in the Asia-Pacific region had not been restored to pre-pandemic levels. Since the outbreak of the pandemic began, livelihoods for income generation in Cambodia and Nepal have been the most severely impacted. In India, Indonesia, and Myanmar, food stock availability in households and availability of essential items in markets improved significantly in 2021 compared to 2020 while the availability of essential items at markets reduced in Vietnam during the time. In 2021, the affordability showed an inconsistent pattern by item and by country, with significant improvement in India and Myanmar but deterioration in Vietnam for rent and loans.

Conclusions: Our results indicate ongoing challenges in food security and livelihood in the region. Long-term social protection programs such as cash transfers and in-kind assistance, need to be carefully designed and implemented to address food insecurity among vulnerable groups, considering each country's market conditions, consumer food purchasing behavior, and financial support size.

Keywords: Food security, Asia Pacific, COVID-19, Income change, Social protection

Conflict of Interest Disclosure: All authors have no conflicts of interest to disclose.

OAB(T9)2-5

Through their eyes and mouths: Inequality in access to food in urban poor settings in Kenya

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Background: Ending hunger and achieving food security for all by 2030 is a core target under the Sustainable Development Goals. Globally, food and nutrition insecurity remains a major challenge. In Kenya, the 2010 Constitution provides for the right to food for all citizens, although this right is not actualized for many, particularly those living in poverty. The urban poor are particularly negatively affected, with over 80% of households in these settings being food insecure. We aimed to explore the lived experiences of the urban poor with food insecurity and the right to food.

Methods: We used participatory methodologies to explore the lived experiences with food insecurity among the urban poor living in slums in Nairobi, Kenya, including photovoice, digital storytelling, participatory mapping, participatory theatre,

community radio shows among others. Thematic analysis was performed using NVIVO software.

Results: Data revealed inequality in access to food, characterized across social, economic, physical and cultural factors, with poverty emerging as a major challenge in access to quality food. While it was reported that there was food available in the market, this food was generally said to be inaccessible to many, and also to be of poor quality. Children, mothers, young people and older people were said to be particularly affected. Under these circumstances, many resorted to coping strategies that on the one hand impacted negatively on health and wellbeing, and on the other enabled innovative means of ensuring food security.

Conclusions: We call on researchers, and other relevant actors to investigate the problem of food insecurity using a lens that accurately reflects the lived experiences of those experiencing it. To end hunger by 2030, further research needs to focus on working with communities experiencing food insecurity as partners whose voices guide advocacy and stimulate the dialogue on the ending hunger. We also call on implementing organizations and decision makers to identify and implement viable context specific solutions to food insecurity for the urban poor, taking into consideration the perspectives of the community with regards to their lived experiences.

Keywords: Food security, Right to food, Urban poor, Nutrition

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OAB(T9)3-1

Perspectives on the application of CONSORT guidelines to randomized controlled trials in nutrition

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Background and objectives: Accurate and complete reporting of nutrition trials is essential for correct interpretation and application of research findings and an avoidable source of research waste. The CONsolidated Standards Of Reporting Trials (CONSORT) statement details the minimum requirements for reporting randomized controlled trials (RCT). To date, however, it remains unclear if additional guidance is necessary to improve CONSORT adherence, utility, and consequent reporting quality of nutrition RCTs.

Methods: As a Federation of European Nutrition Societies working group, we assembled an international and geographically diverse committee of experts across a range of nutrition trial domains. First, we applied an iterative process to interrogate the 2010 CONSORT items as they relate to nutrition trials, implemented as a series of regular online consultations over 12 months. Specific CONSORT items potentially requiring additional guidance for nutrition were discussed, and agreement was reached on the main points. In a second step, we will collect feedback from a wider audience of nutrition researchers, journal editors, and other relative experts in the field, asking them to comment on our findings and identify other items and possible gaps, to generate areas of consensus and unresolved matters. Further, in a third step, we plan to also collect feedback via a Town Hall meeting for attendees at IUNS 2022.

Results: Sixteen of the 25 CONSORT items, as well as an additional item not listed, were identified as potentially requiring additional guidance when reporting nutrition RCTs. We will map the findings of the working group from step 1, with those of the peer-review in step 2, to identify areas of consensus and additional items and issues, to capture priority items for future work. The external review process is underway and will be summarized for the IUNS congress.

Conclusions: Adequate reporting is foundational to creating a robust and valid evidence base for informing the development of nutrition guidelines for policy and practice. We provide perspectives for future assessment of whether specific guidance, such as a dedicated extension to CONSORT for nutrition, is warranted, and provide a narrative, documenting items that may need explicit reporting for nutrition trials.

Keywords: Guidelines, CONSORT, nutrition trials, reporting, expert opinion

Conflict of Interest Disclosure: No conflicts of interest to disclose

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OAB(T9)3-2

A case study on the public-private-partnership in "Ghana Nutrition Improvement Project" using MIT D-Lab's P.ACT (Patnreship Co-design Toolkit)

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Background and Objectives: In Ghana, child malnutrition is still a predominant challenge with a national stunting prevalence rate of 21% (2018). The Ajinomoto Foundation (TAF) is leading the “Ghana Nutrition Improvement Project” aiming to improve nutrition of children aged 6 months to 24 months by providing a nutrition supplement called “KOKO Plus”, which is added to traditional complementary food, koko, corn-base porridge. TAF is engaged in a collaboration with Ghana Health Service (GHS), Ministry of Health to deliver effective nutrition education to mothers, which is considered to be a key factor for the success of the project.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Published in 2020, the P.ACT (Partnership Co-design Toolkit) was co-developed by MIT D-Lab and SEED to equip impact practitioners with practical tools and methods to co-create inclusive hybrid partnerships. The objective of this study was to apply the P.ACT to strengthen the public-private partnership for nutrition improvement.

Methods: The Public Private Partnership between GHS and TAF was analyzed by using a selected number of P.ACT tools through participatory workshops (total six on-line workshops) that convened representatives from TAF and GHS and were facilitated by MIT D-Lab.

Results: The P.ACT workshops enabled GHS and TAF to identify key success factors as well as opportunities to improve and strengthen their partnership for the future. The partners identified the following factors as some of the key strengths they can leverage and build upon for the future of the collaboration: strong alignment for impact goals, complementary capabilities, clear value chain roles and balanced returns. The P.ACT engagement also revealed several opportunities to further strengthen the partnership model: co-creating a dashboard of Key Success Metrics (KPIs) and sharing a plan to reach financial sustainability. A follow-up evaluation of the partnership and an assessment of the KPIs were conducted after the P.ACT workshops.

Conclusions: The case study demonstrated that P.ACT is an effective Toolkit in diagnosing and improving public-private partnerships for nutrition improvement projects. It was useful in achieving the key objective of providing effective nutrition education through the partnership.

Keywords: Public-private-partnership, nutrition education, P.ACT toolkit

OAB(T9)3-3

The current status of food environmental policies of public and private sectors in Vietnam

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Background: Public and private policies are important to promote a healthy food environment. A review of nutrition/food policies and a comparison of the extent to which current government policies on food environments across the world can catalyze policies and actions. The benchmarking of private sectors by assessing the commitments of food companies to improving population nutrition usé the Business Impact Assessment on population nutrition and obesity (BIA-Obesity) tool.

Methods: The Healthy Food-Environment Policy Index (Food-EPI) were used to evaluate government policy practice. Rating results were used to identify and propose policy actions. BIA-Obesity good practice indicators for food industry commitments were adapted to the Vietnam context. Euromonitor market share data was used to identify major food, beverage manufacturers, restaurants and retailers (n=29). Commitments and disclosures collected against the BIA-Obesity scoring criteria were assessed by qualified Expert panel and recommendation were formulated by Review panel

Results: Using Food-Epi. no indicators were rated "high", the majority of the index was rated as "low" at 53%, while the "very low" level, following closely behind at 40.5 % and only 6.5% rated as "medium". The top 3 indices were ranked the highest level of performance in the "average" ranking, including (1): index of ingredient list/nutrient statement (52%) (2): school policies to improve healthy food (44%) and (3): develop regulatory systems for health and nutrition claims (43%). The top 3 indexes that received the lowest scores in the "very low" ranking were (1): support and training for the private sector (16%); (2): the policy of food service stores that provide healthy and unhealthy food (18%) and (3): manage regulatory capacity for nutrition (16%). Of the 29 selected companies, none of them agreed to provide more information. The median overall BIA-Obesity score was 10.3%, only 2/29 companies achieve score over 25%. Relationships with organizations (average score of 25.1%) was the highest score domain while healthy product formulation, accessibility, and advertising of healthy food products were scored the lowest (<10%)

Conclusions: Study findings are basic for developing new policies conducive for nutrition/health and strengthen civil society advocacies for government accountability to create a healthier food environment.

Conflict of Interest Disclosure: The authors declare no conflict of interest disclosure

Keywords: Food Epi, BIA Obesity, Nutrition and Food policies, Public policy, Private policy

OAB(T9)3-4

The role of Food and Beverage manufacturers in the food system, do they work towards eradicating all forms of malnutrition?

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Background and objectives: Every day a large part of the global population experiences malnutrition resulting from an unhealthy diet. Our food system is failing to deliver healthy diets at an affordable price for all. A key actor in the food system are food and beverage (F&B) companies. ATNI's Global Index (GI) assesses how the world's largest global F&B companies contribute to addressing malnutrition in all its forms. The work presented here summarizes the changes observed in F&B performance measured by four GI iterations between 2013 and 2021.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: Companies were assessed on their nutrition-related commitments, practices, and disclosure – with regards to governance and management; the production and distribution of healthy, affordable, products; and how they influence consumer choices and behavior. Different indicators, divided across seven topics, are summed up in a total GI score of a company. This includes a Product Profile exercise, which provides an independent assessment of the nutritional quality of companies' product portfolios using the Health Star Rating model.

Results: Overall, a small increase in the average GI score (from 2.2 in 2013 to 3.3 in 2021 out of 10) was observed over the years, more attention for health and nutrition in companies' commercial strategies and strategies related to improving nutrition quality of portfolios led to an increased score for most companies. The largest progress was seen in governance as most companies' business strategies and management systems strengthened focus on nutrition. Affordability is a low scoring topic for most companies as few can show evidence of considering low-income groups when pricing their healthy products. While improvements in the Product Profile scores are observed for some companies, results show that progress is too slow, with only 31% of products meeting the healthy threshold in 2021.

Conclusions: The observed increase in the average GI score indicates a growing awareness amongst leading F&B manufacturers on the importance of producing healthy products and integrating nutrition as part of their broader sustainability strategies. It shows companies are willing to take actions towards eradicating all forms of malnutrition, though more steps need to be taken, especially regarding affordable pricing and delivering healthy products.

Keywords: Index, Food and Beverage manufacturers, undernutrition, overnutrition, healthy products

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OAB(T9)3-5

The steady increased of Obesity and Non-Communicable Diseases in Indonesia: What needs to be done?

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Background and Objectives: Obesity is a global public health concern, and has increased significantly worldwide, including Indonesia. This article aims to prove the prevalence of obesity in Indonesia which has had increasing in parallel with the increased of various non-communicable diseases/NCD.

Methods: Descriptive analysis uses available data from the Indonesian National Health Survey 2007 to 2018 to see trends in the prevalence of obesity and its impact on the increasing prevalence of non-communicable diseases. Related factors were also observed regarding the characteristics of the population, and other factors such as consumption of sugar-salt-fat, habits of consuming vegetables and fruits, and habits of physical activity.

Results: Within 5 years (2007 to 2013), the prevalence of Adolescent Obesity rose 5.2 percentage points in younger age adolescents (13-15 years) and up to 6.2 percentage points in older adolescents aged 16 to 18 years. The condition of obesity among adults age 18+ years has also increased from 10.3% in 2007 to 21.8% in 2018. At the same time the trend of NCD for adult aged 18+ years also increased significantly. On the other hand, the population who suffered from various NCD, hypertension, diabetes, cancer, obesity altogether have increased from 33.5% in 2007 to 47.7% in 2013. The risk factor of obesity and NCD needs serious attention. While there are no data available about the relationship between malnutrition in the early life with obesity and NCDs, it has recorded that the proportion of Sedentary Activity more than 6 hours/day among population 10+ years was 24%, less consumption of fruits and vegetables was 93.5%, and 29.7% of population are already excessive in daily intake of Sugar-Salt-Fat.

Conclusions: Indonesia is currently challenged by the needs to take more serious action to decrease the current escalation of obesity and NCD. The national strategy should not only address a healthier life style of adolescents and adult population through the healthy movement program, but also focusing on malnutrition during early life. Regulations on sugar-salt-fat content of food and beverage production need to be implemented immediately.

Keywords: Obesity, NCD, Healthy Community Movement

Conflict of Interest Disclosure: All authors whose names are listed above declare that they have no conflicts of interest

Further Collaborators: None

OAB(T9)3-6

Food labeling as a tool to investigate the nutritional quality of foods: Results from the food labeling of Italian products (FLIP) study

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Background and objectives: Based on the European legislation, food label includes the nutrition declaration that may be an useful tool to estimate the nutritional quality of food products. The Food Labelling of Italian Products (FLIP) study, performed by the Young Working Group of the Italian Society of Human Nutrition (SINU), aims to 1) systematically investigate the overall quality of prepacked foods sold on the Italian market by retrieving the information reported on the food pack; 2) investigate if specific information present of the food pack (e.g., nutrition claim, organic declaration, brand) may be considered as markers of the overall quality.

Methods: The survey was designed as a comprehensive analysis of food products belonging to different food categories (e.g., bread, meat analogues, breakfast cereals) sold in the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

websites of 13 out of the major retailers present on the Italian market. For each product the nutritional declaration per 100 g of products was collected together with other information reported on the food pack (e.g., brand, nutrition and/or health claims). Statistical analyses of the nutritional values were carried out using IBM SPSS Statistics for Macintosh, Version 26.0. Armonk, NY: IBM Corp, setting the significance level at $p < 0.05$).

Results: Results reported a high variability in terms of nutritional quality, with products belonging to the same category and even type but widely differing for their nutritional content. Moreover, the sub-analysis based on the presence of absence of specific information on the food pack revealed that overall no information such as nutrition claim, brand or organic declaration can be considered as markers of the overall quality of food.

Conclusions: Overall, the present work highlighted a high variability in the nutritional quality of foods currently on the market. Thus, this study supports the importance of reading and understanding the information made on food label.

Keywords: food label, nutrition declaration, food choice, nutrition and health claims

Conflict of Interest Disclosure: Authors declare no conflicts of interest

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OAB(T9)3-7

Compliance of pre-packaged food products with the Nigerian national food and nutrition labelling regulations

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Background and objectives: The rising prevalence of non-communicable diseases (NCDs) in Sub-Saharan Africa strengthens the need to furnish consumers with appropriate information on the composition/content of pre-packaged foods. This study was designed to examine the food and nutrition labelling compliance of pre-packaged foods sold in Nigerian markets with the national guidelines.

Methods: A total of 662 pre-packaged foods from 10 broad categories were purposively enlisted from Nigerian stores and supermarkets. The food label information was compared with eleven (11) food and other nutrition labelling requirements stipulated by the National Agency for Food and Drug Administration and Control (NAFDAC).

Results: Results showed that half (50.5%) of the products were manufactured in Nigeria. Almost all of the pre-packaged foods complied with guidelines on food label information declaration (92.9%), product name/description (98.4%), ingredient list (95.1%), net quantity (94.5%), manufacturer's information (92.6%) and date of minimum durability (89.6%). Less compliance was reported for quantitative ingredient declaration (35.6%), instructions for use (45.4%) and allergen declaration (48.7%) guidelines. This accounted for an overall mean food label compliance score of 8.42 $\pm$ 1.74 out of a possible 11.0 score. Adherence to NAFDAC food label requirements was high in breakfast cereals (9.63 $\pm$ 1.52) and noodles/pasta (9.30 $\pm$ 1.67) but low in fats/oil (6.70 $\pm$ 2.00) and meat/fish (6.97 $\pm$ 1.27). Nutrition label information revealed a low prevalence (33.4%) of nutrient claims. For products with nutrient claims, most (64.6%) of these claims were stated in accordance with NAFDAC guidelines. Compliance with the declaration of four micronutrients was low (42.0%) in all products but high (86.9%) in products with claims. A higher likelihood of declaration of these macronutrients in products with nutrient claims (OR = 27.33; 95% CI = 17.32 - 43.12) was observed. Compliance with food labelling requirements was positively correlated with macronutrients declaration ($r = 0.28$; $p = 0.00$).

Conclusion: High compliance with food label guidelines was reported but nutrition label requirements were not adequately met, particularly foods with no nutrient claim. Enforcement of compliance with food/nutrition label guidelines is fundamental to the reduction of NCDs risk.

Keywords: Compliance, food/nutrition labelling, non-communicable diseases, national guidelines, Nigeria

Conflict of Interest Disclosure: The authors have no conflict of interest to declare

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OAB(T9)3-9

"Stronger With Breastmilk Only" (SWBO) Initiative to Improve Breastfeeding Environment in Burkina Faso: Contribution Analysis of the Advocacy and Partnership Components

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Background and objectives: The practice of giving water before six months of age is one of the most important barriers to exclusive breastfeeding (EBF) in several countries in the West and Central African region, and Burkina Faso is no exception. To address this challenge, an initiative was carried out in Burkina Faso as part of a West African regional initiative called "Stronger with Breastmilk Only" (SWBO). This study assessed if and how the advocacy and partnership activities carried out under the SWBO initiative in Burkina Faso have resulted in a policy and programmatic environment that is more supportive of breastfeeding (BF).

Methods: The study used contribution analysis, a theory-driven evaluation method, in addition to applying two study lenses: 1) a set of metrics proposed for effective advocacy to examine advocacy efforts, and 2) the Breastfeeding Gear Model to appreciate the efforts around BF in the SWBO initiative.

Results: Key advocacy activities - the development of a national strategy for SWBO, advocacy meetings, and training of key actors - were supported by 1) a tripartite alliance, composed of the Ministry of Health, UNICEF and Alive & Thrive, with strong advocacy capacity, 2) a network of committed partners and 3) awareness-raising activities. Carried out at multiple levels (political, organizational, social and community), the advocacy and partnership activities contributed significantly to the commitment of various stakeholders throughout the implementation of the initiative. Their mobilization enabled the adoption of regulations that protect, promote, and support BF, and the allocation of funding to BF efforts. A multi-sectoral committee was key to coordinate partners' efforts toward the same objectives and measures were put in place to better monitor BF programs. Finally, the SWBO initiative acted upon the 8 gears (advocacy; political will; legislation & policies; coordination; funding; training and program delivery; promotion; research and evaluation) of the Breastfeeding Gear Model which helped to achieve progress toward these BF-enabling environments.

Conclusions: Advocacy and partnership activities allowed for the sensitization of key actors, such as government decision-makers, financial partners, journalists or national champions and their subsequent mobilization contributed to strengthening the policy and programmatic environment for EBF.

Keywords: nutrition advocacy, contribution analysis, breastfeeding environment, theory of change, Breastfeeding Gear Model

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OAB(T9)4-1

The Multiple Micronutrient Supplementation Cost-Benefit Tool: A Catalyst for Accelerating Maternal Nutrition Policy and Investment Decisions

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1. Nutrition International (Canada)

Background and Objectives: Recent evidence shows multiple micronutrient supplements (MMS) for pregnant women, a daily tablet containing 13-15 vitamins and minerals including iron and folic acid, provide additional health benefits for newborns compared to iron-folic acid supplements (IFAS) alone. MMS is safe for mothers and their newborns and cost-effective. Stemming from this evidence and updated guidance from the World Health Organization (WHO), many low- and middle-income countries (LMICs) are considering transitioning from IFAS to MMS for routine antenatal care programming. The objective is translated economic evidence, to provide national governments with context-specific analyses on cost and cost-benefit for policy and program decisions.

Methods: Nutrition International developed the online MMS Cost-Benefit Tool (The Tool) using a rigorous methodology to estimate potential health impact, budget impact, economic value, cost-effectiveness, and benefit-cost ratio of investing in MMS compared to IFAS. Analyses were conducted and pre-loaded in the Tool for 33 LMICs. The analyses were extracted from The Tool and translated into policy briefs. By request, The Tool was used to model the cost-effectiveness of transitioning to MMS for select LMICs to provide data for the WHO's *Nutritional Interventions update*: MMS during pregnancy (2020)

Results: For all countries in The Tool, analyses show that transitioning from IFAS to MMS would generate substantial health benefits in terms of morbidity and mortality averted, is "very cost-effective", and would provide a high return on investment. The average cost per Disability Adjusted Life Years averted is 23.61 USD and benefit-cost ratio ranges from 41-1,304 USD which demonstrates MMS is good value for money compared to IFAS. Customized country policy briefs translate this evidence to action for ministries of health and finance and other key decision makers. The Tool is informing global action through the WHO guideline update and country-level action,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

including updates to national guidelines throughout Africa and Asia.

Conclusion: With its user-friendly design, open access availability, and dynamic, data-driven analytics, The Tool is a powerful resource for governments and nutrition partners. The Tool provides timely and evidence-based analyses to inform policy-decisions, implementation research, and investments towards the scaling of MMS programs for pregnant women in LMICs.

Keywords: Multiple Micronutrient Supplements (MMS), Multiple Micronutrient Supplementation, Maternal Nutrition, Cost-effectiveness, MMS Cost-Benefit Tool

Conflict of Interest Disclosure: None

Further Collaborators: Bahman Kashi, Limestone Analytics, Zuzanna Kurzawa, Limestone Analytics, Allison Verney

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OAB(T9)4-2
Cost and affordability of healthy diets in Vietnam

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Background and objectives: As the essential drivers of dietary quality, the cost and affordability of healthy diets challenge food security, nutrition, and health. In Vietnam, long-term national nutrition and food security success require special attention to the supply and access to healthier foods for all population groups to ensure higher dietary quality. The aims of this study were to estimate the minimum cost to meet the healthy diets recommended by 2016-2020 Vietnamese food-based dietary guidelines, compare the cost differences by food group, region, and seasonality, and assess the affordability of healthy diets.

Methods: The cost of healthy diets was estimated by the Cost of Recommended Diet indicator, based on monthly Consumer Price Index prices data of 176 food items from January 2016 to December 2020. Affordability was determined by comparing the cost of healthy diets to a standard of both food expenditure and income, which are calculated from the three latest Vietnam Household Living Standard Survey (VHLSS), including VHLSS 2016 (9,399 households), VHLSS 2018 (9,167 households), and VHLSS 2020 (9,388 households).

Results: The average cost of healthy diets from 2016 to 2020 in Vietnam was 3.08 dollars in 2017 Purchasing Power Parity (24,070 Vietnamese Dong). The nutrient-rich food groups, including protein foods, vegetables, fruits, and dairy, composed approximately 80% of the total cost of healthy diets in all regions. Particularly, dairy accounted for the largest portion of the total cost. We estimate that approximately 60% of Vietnamese low-income households could not afford healthy diets.

Conclusion: Our findings suggest that it is crucial to facilitate interventions in local food systems to reduce the cost of nutrient-rich foods, supporting the attainment of higher dietary quality in the Vietnamese population, especially for low-income households.

Keywords: cost of healthy diets, food-based dietary guidelines, dietary quality, affordability, seasonality

Conflict of Interest Disclosure: The authors have no conflicts of interest to declare.

OAB(T9)4-3
Developing a Healthy Diet Basket for global monitoring of the cost and affordability of healthy diets

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Background and objectives: The cost and affordability of a healthy diet is crucial to understanding whether people can access healthy diets, such as those recommended in national food-based dietary guidelines (FBDG). The objective of this work was to develop a comparable standard of a healthy diet, for the purpose of calculating and comparing the cost and affordability of healthy diets across countries.

Methods: Recent and quantifiable national FBDG were identified in all regions of the world. These were quantified in terms the range and average amount in dietary energy (kcal) of each food group recommended per day per person, proportionally standardized to meet a total dietary energy value of 2329 kcal (the requirement for an average 30-year-old woman). Average amounts of each food group across guidelines were determined and used to construct a Healthy Diet Basket (HDB). The cost of the HDB and each of the originally quantified FBDG was found by analyzing food price data from 177 countries globally from the World Bank International Comparison Program (2017). The macro- and micronutrient content was calculated for the resulting least-cost set of items in each country.

Results: The Healthy Diet Basket is proportionally similar to the national FBDGs from which it was derived, as well as additional non-quantified national food guides. The cost of the HDB was slightly less than $3.50 on average across countries. Based on analysis of least-cost baskets of foods meeting each guideline, the mean adequacy ratio (MAR) of the HDB was 94%, identical to the average MAR across national FBDG.

Conclusions: The Healthy Diet Basket (HDB) is a transparent, global standard set of criteria that represents commonalities across most FBDG globally and satisfies nutrient needs. It is appropriate to use for comparing the cost and affordability of healthy diets across countries. Even least-cost diets meeting this standard are unaffordable for many people in the world,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

pointing to the need for accelerated action to make healthy diets accessible for all.

Keywords: food prices, food security, economics, food-based dietary guidelines

Conflict of Interest Disclosure: None

Further Collaborators: None

OAB(T9)4-4

Measurement and reach of nutrition sensitive social protection programs in South Asia: an analysis of nationally representative surveys from 2012 to 2019

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Background and objectives: Social protection programs with conditions added to enhance their nutrition sensitivity – such as linking of a cash/in-kind transfer to health service delivery – are termed nutrition sensitive social protection programs (NSSPPs). In South Asia, the global region with the most malnourished individuals, NSSPP coverage remains poorly described. We assessed data availability and examined coverage and inequities of NSSPPs in South Asia.

Methods: After identifying NSSPPs in seven countries (Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka), we assessed data availability in nationally representative household expenditure and health surveys. Coverage was defined as the percentage of households covered by government cash and/or food transfers in the past year. To understand if NSSPPs reached vulnerable households, we estimated coverage among all households, households with children <5 years, and by wealth quintiles or residence type. Finally, we examined co-coverage of NSSPPs and health/nutrition interventions during pregnancy.

Results: Data on NSSPPs were available only in datasets from three (Bangladesh, India, Nepal) of the seven countries. In Bangladesh, 18% of households reported receiving either cash or food transfers. In India, 52% of households received a subsidized food ration. In Nepal, 22% of households received cash but no data were available on food transfers. Coverage of NSSPPs in households with children <5 years was similar to coverage among all households. In all countries, coverage of NSSPPs exhibited a pro-poor and pro-rural gradient. Although half of women received food during pregnancy in India, only 2% received both food and health/nutrition interventions (having at least 4 antenatal care visits, consuming at least 100 iron folic acid tablets, deworming, and receiving tetanus injections). Co-coverage of cash plus health/nutrition interventions was 1% in India and 21% in Nepal.

Conclusions: Most NSSPPs in South Asia are not captured in routine large-scale surveys. To improve tracking and reach of NSSPPs, efforts are needed to close these measurement gaps. Where data are available, our findings suggest that NSSPPs are reaching poorer households, but coverage remains low. Co-coverage of NSSPPs with health/nutrition interventions is poor, suggesting missed opportunities to reach vulnerable households with multisectoral interventions.

Keywords: NSSPPs, South Asia, Coverage, Co-Coverage, Inequity

OAB(T9)4-5

Development of an innovative global online continuing medical education course for improving health providers' capacity in maternal nutrition

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Background: Nutrition in pregnancy is critical for achieving optimal maternal and child health outcomes, yet gaps in facility and community health provider knowledge and key competencies to deliver maternal nutrition interventions during routine health contacts persist globally.

Objective: We developed a free continuing medical education course with the objective of improving nurses, physicians and nutritionists' knowledge of the global burden and consequences of maternal malnutrition, the importance of maternal dietary intake during pregnancy and lactation, appropriate weight gain during pregnancy, and evidence-based interventions to improve maternal nutritional status through diet, and micronutrient supplementation. Health service delivery considerations include improving provider communication and counseling skills, social behavior change interventions, strengthening facility and community linkages, and advocacy for the introduction and scale-up of evidence-based interventions within the policy enabling environment will be explored.

Methods: An online Learning Management System platform will be used for the virtual course-. Learners will be guided through six modules presented by global experts and will gain additional training considerations for inclusion of maternal nutrition in the design and implementation of country programs. Learners can also draw upon lessons learned from country case studies from Latin America, Asia and Africa, which will be developed in collaboration with local professional organizations and in-country nutrition experts. Preliminary data on effectiveness of the course in improving provider knowledge were collected through a pre-post course evaluation, as well as via qualitative methodologies.

Results: The course launched in mid-2022. Key takeaways include: the design in planning and implementation of the course, and initial evaluation data on changes in provider

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

knowledge, as well as content on key lessons learned from the first set of country case studies.

Conclusion: Strengthening provider knowledge and capacity on nutrition is critical to provide quality health services during antenatal care and postnatal care. Expansion of Continuing Medical Education with global reach is much needed to aid in improving maternal nutrition knowledge and skills by combining teachings from global and local experts with practical country case studies.

Keywords: Maternal nutrition, antenatal care, postnatal care, continuing medical education

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

OAB(T9)4-6

Positioning Nutrition within Universal Health Coverage: optimizing health financing levers to turn commitments into action

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Background: Achieving universal health coverage (UHC) is a top global priority, and nutrition actions are a critical part of meeting that goal to not only reduce the burden of disease, but also prevent permanent physical and cognitive impairments, ultimately staving off future health care costs for both individuals and health systems. However, coverage and quality of nutrition service delivery remains low, despite robust evidence of cost-effective interventions. There are gaps in knowledge on how to deploy health financing levers more effectively to improve the delivery of nutrition services as part of preventive and promotive health care.

Objective: The study aims to provide practical knowledge to policymakers on "how" to use health financing levers—revenue raising, pooling, and purchasing—to improve nutrition service coverage and quality as part of the movement toward UHC, thus bridging the disconnect between known advantages of investing in nutrition with actionable recommendations.

Methods: Based on internal expert consultations, we constructed a five-part analytical framework consisting of: Prioritization of nutrition services in national health plans; Financing arrangements for nutrition within the health system and its challenges on nutrition services; Optimization of health financing levers to improve quality nutrition service delivery; and Roles of other health system features in enabling the optimization of health financing arrangements. Accordingly we conducted literature reviews and key informant interviews for global evidence synthesis and country deep-dive analyses to identify challenges and options for optimization of health financing levers. Peru, Indonesia, Rwanda, Ethiopia and Thailand were selected for country analyses.

Conclusion: The revenue raising lever can be optimized through evidence-based planning and resource allocation based on disease burden of nutrition/diet-related risk factors while innovative fiscal policies, such as diet-related taxation, can also be explored amidst serious fiscal constraints around the world. On pooling, countries can reduce fragmentation by aligning financing sources, harmonizing benefits and facilitating cross-subsidization relative to need. For the purchasing lever, costed and prioritized nutrition package of services need to be explicitly included in the UHC benefits package and reforms on community-based provider contracts is key to delivering quality nutrition services to the most vulnerable.

Keywords: nutrition, universal health coverage, health financing reforms, health system strengthening, quality service delivery

Further collaborators: Meera Shekar, Benoit Mathivet, Somil Nagpal, Lisa Saldanha (World Bank) and Laurence Grummer-Strawn (WHO)

Conflict of Interest Disclosure: The authors declare they have no conflicts of interest.

Further Collaborators: Meera Shekar, Benoit Mathivet, Somil Nagpal, Lisa Saldanha (World Bank), and Laurence Grummer-Strawn (WHO)

OAB(T9)4-7

Operationalizing Multisectoral Nutrition Program to Accelerate Progress: A Nutrition Governance Perspective

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Background: Given the complex, multifactorial, and interlinked determinants of nutritional status and well-being, multisectoral nutrition programming that converges on vulnerable populations has been widely promoted as the most effective way to address the direct and indirect determinants of malnutrition and improve nutrition outcomes. Robust governance systems are essential for implementing multisectoral nutrition interventions and creating cost-effective and sustainable programs.

Objective: The purpose of this report is to delineate valuable lessons learned from selected countries in operationalizing large-scale multisectoral nutrition programs that emphasize and strengthen governance. The focus countries have demonstrated innovative approaches to address systemic governance challenges and highlighting the need for "business not as usual" to accelerate progress.

Methods: The report draws on a desk review of the current literature and project documents on multisectoral nutrition interventions and the role of governance in carrying out these interventions. The review includes the implementation progress of extensive technical assistance and analytics that covers

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

knowledge-sharing, diagnostics to inform evidence-based advocacy, project design and formulation, and support for implementation and monitoring and evaluation.

Conclusion: The report highlights the following areas: (i) continued need strengthening routine data systems that enable continuous tracking of nutritional status, service coverage/utilization, and quality of care; (ii) improvement of public financial management system to enable tracking of nutrition spending across sectors to enhance accountability; (iii) investments in technologies that improve the availability and utilization of high-quality nutrition data, including those that enhance the interoperability across data system; (iv) build capacity and incentives to implement multisectoral interventions at national and subnational levels; and (v) citizen engagement to strengthen community-level decision-making and accountability processes to strengthen the demand for quality services and enhance program course corrections.

Keywords: Nutrition, multisectoral approach, governance, public financial management, quality service delivery

Disclosure: The authors declare they have no conflicts of interest.

Further collaborators: Peer reviewers: Stuart Gillespie, Anne-Marie Provo and Laura Rawlings

Conflict of Interest Disclosure: The authors declare they have no conflicts of interest.

Further Collaborators: N/A

OAB(T9)4-8

Building the case for nutrition: A pilot methodology and approach to mobilize investments for tackling malnutrition in all its forms.

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Background and objectives: There is clear opportunity to expand the coverage of nutrition investment cases beyond the common focus of undernutrition in mothers and children, to reach individuals at various stages throughout the life cycle. Under the Global Joint Programme to Catalyse Multisectoral Action on noncommunicable diseases (NCDs), UNDP, WHO, and the United Nations Interagency Task Force on NCDs have developed a methodology to build NCD investment cases. Already 26 investment cases on NCDs have been completed and launched globally. UN Nutrition and UNDP, supported by WHO, will build upon the established methodology to develop an approach for investment cases that address malnutrition in all its forms and will produce a pilot investment case for a country complete with an economic and political analysis. These investment cases will support governments to make a compelling, evidence-informed advocacy case for investments in nutrition interventions that address the growing prevalence of undernutrition, overweight, obesity and diet-related NCDs.

Methods: Our team of policy analysts, health and nutrition experts and economists will develop a list of feasible interventions from the OneHealth Tool (OHT) best suited to address malnutrition in all its forms to be analysed in an economic model, while specifying underlying assumptions and impact pathways. The team will produce a guidance note on methodologies to estimate the burden of malnutrition. The team will finalise economic models and frameworks on the impact, costs and returns on investment (ROI) for nutrition interventions. For a pilot country, the team will cost nutrition interventions and calculate ROIs over 5- and 15-years, monetizing the health benefits and averted treatment costs.

Results: A pilot nutrition investment case with a political component and summary of the economic findings will be developed. A report summarizing the methodology, results, and learning from the pilot investment case will be made available for replication in other countries.

Conclusion: This work can build upon established methodologies to expand the accessibility and reach of nutrition investment cases in countries where they are needed most.

Keywords: nutrition, noncommunicable diseases, investments, modelling, methodology

Annals of Nutrition and Metabolism

Poster Abstract Presentations

PAB(T1)-1

Correlation of Vitamin D Concentration, Glycaemic Control, Cytokines and Adipokines in Adults with Type 2 Diabetes Mellitus in Mexico

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Background and objective: Diabetes mellitus is a chronic and multifactorial disease which according to the WHO affects 422 million individuals; 90% have Type 2 Diabetes Mellitus (T2DM). Currently, scientific evidence suggests that patients with T2DM have low concentrations of vitamin D and systemic inflammation; these factors aggravate symptoms and cause complications. The objective was to establish associations between glucose, insulin, cytokines, adipokines and vitamin D in adults with T2DM in Mexico.

Methods: A cross-sectional study was undertaken, which included 93 adults from 25 to 60 years old, both sexes, selected from outpatient public clinics in Toluca, Mexico State. Their participation was voluntary. Clinical baseline markers, anthropometrics, glycemic control such as glucose, insulin, Hb1Ac, HOMA-B and HOMA-IR were calculated; additionally, cytokines, adipokines and vitamin D status were measured. Spearman correlation was used to determine associations.

Results: A significant correlation ($p > 0.05$) was found between IL-1β, 1L-10, IL-8, IL-6 IL-12, TNF-α and IFN-γ and vitamin D serum concentrations. Leptin had a positive correlation with insulin and HOMA-B. Also, glucose correlated with leptin, IL-12, IFN-γ, insulin, HOMA-B and HOMA-IR. Finally, a significant Vitamin D deficiency in all patients was found (<20 ng/ml). No significant associations were found between vitamin D binding protein and other markers.

Conclusion: This Mexican population with T2DM had a significant deficiency of vitamin D, associated with various cytokines.

Keywords: Vitamin D, Type 2 Diabetes Mellitus, Cytokines, Adipokines, Mexico

Conflict of Interest Disclosure: No conflict of interest

PAB(T1)-2

Glycemic index, glycemic load, and lung cancer risk: a meta-analysis

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Objective: Glycemic index (GI) or glycemic load has been investigated in the field of cancer research for several years. However, the relationship between GI or glycemic load and lung cancer risk remains inconsistent. Thus, this study aims to summarize previous findings on this relationship.

Methods: PubMed, Web of Science databases, and Cochrane Library were searched by July 2021. This review was in accordance with the PRISMA guidelines. A fixed-effects or random-effects model was adopted for meta-analysis to compute the pooled relative risks (RR) and their corresponding 95% confidence intervals (CIs). Subgroup analyses, sensitivity analyses, and publication bias analyses were also performed.

Results: In total, nine articles were included with four case–control studies and five cohort studies. After merging the studies, pooled multivariable RRs of lung cancer based on the highest versus the lowest intake were 1.14 (95%CI: 1.03–1.26) and 0.92 (95%CI: 0.86–0.98) for GI and glycemic load. Results persisted in most stratifications after stratifying by potential confounders in the relationship between GI and lung cancer risk.

Conclusion: In this paper, GI typically has a positive relationship with lung cancer risk. This negative finding between glycemic load and lung cancer risk provides evidence on the association issue based on current evidence and suggests that this issue should be studied and verified further to substantiate these findings.

Keywords: Manuscript, Glycemic index, Glycemic load, Lung cancer

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-3

Is thinness and eating disorder associated with an inability to eat beyond hunger?

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Background and Objective: Self-regulation of energy intake is essential for health. An inability to eat less following a high energy preload (eating beyond hunger) has been associated with overweight, but it is unclear whether an inability to eat beyond hunger places children at risk of undernutrition. The preload satiation methodology is a standard, within-subject, crossover experiment which generates a measure of energy regulation, the compensation index (COMPX). Our systematic review and meta-analysis of 20 published studies found the average COMPX among healthy children aged 2-7 years to be 68%.

We aimed to measure energy regulation in thin children with severe feeding problems, compared to published data on healthy children.

Methods: Pilot satiation studies were then conducted among thin children (BMI <-1.66 kg/m^2) aged under 7 years attending a UK tertiary feeding clinic. On two visits, >7 days apart they were given similar drinks containing either minimal energy, or 10% of daily requirements, with parents and researcher blinded to the condition. After 30 minutes children were offered a large test meal, the same on each day. The energy consumed was calculated from before and after weighing. Parents rated child's eating behaviour using the International Complementary Feeding Evaluation Tool (ICFET); scores of avidity, food refusal and food frequency were expressed as z scores and compared to the UK population using one sample t-test.

Results: Nine children aged median (range) 55 (28-75) months were recruited and completed the full protocol. They had low mean [SD] avidity (-1.36 [1.2]; P=0.009) and food frequency (-1.3 [1.4]; P=0.024) Z score, but their refusal score was near average (0.45; P=0.4). All children ate less at the meal after the high energy preload, resulting in similar total energy intake (meal plus preload) for both conditions (Low, 246±64 kcal, High, 246±66 kcal). The mean COMPX was 104 ± 39%, 36% points higher than for healthy population (one sample t-test = 0.025) with 4 children over-compensating (>100%).

Conclusion: This pilot study suggests that thin, eating disordered children regulate their energy intake precisely. Further research will consider whether an inability to eat beyond hunger predisposes to childhood undernutrition in lower income settings.

Keywords: Satiation, Energy regulation, compensation, thinness, Malnutrition

PAB(T1)-4

Finding key barriers and enablers influencing the nutrition behavior using a formative research, Barrier Analysis Study in Myanmar

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Background and objectives: Myanmar is one of the countries with high stunting rate among under 5 children (29.2% in 2016), with continued violence and conflict, and collapsed health system. To increase the effectiveness of the project approach, Save the Children team and the implementing partners conducted formative research using the barrier analysis (BA) methodology in 9 townships in 5 states and regions to study the barriers and enablers of Nutrition, WASH, and Health behaviors. The results of the barrier analysis are to be used to inform and strengthen the behavior change strategy of the project. Specifically, the findings will inform the development of the project activities, the supporting environment for the priority groups, Essential Nutrition and Hygiene Action lessons and job-aids to ensure messages that are context specific, culturally appropriate, and effective in eliciting behavior change through addressing localized barriers and enablers.

Methods: The Barrier Analysis (BA) was selected as the formative research tool to inform and fill gaps within the behavior change strategy.

Results: Getting the information about the significant determinants influencing the nutrition behaviors of the priority groups, Save the Children and Implementing Partners were able to strengthen the Social Behavior Change and Communication projects. This impacts the positive behavior change of the mothers and caretakers who are taking care of the children, increasing minimum dietary diversity from 53% to 60%, and acceptable diet from 52% to 59% in a year in displaced people in Rakhine state, Myanmar.

Conclusions: The BA was the preferred formative research method for two key reasons: the BA is a rapid form of formative research and national field staff can conduct the BA. It can inform the project to design the behavior change framework for the targeted community group in positively changing the nutrition behaviors.

Keywords: Barrier Analysis, Determinants, Formative Research, Minimum Dietary Diversity, Acceptable Diet

Conflict of Interest Disclosure: The authors have used the information and data from Save the Children BHA project, Save the Children BRICKs project and the Barrier Analysis Guideline of Bonnie Kittle.

Further Collaborators: Bonnie Kittle

PAB(T1)-5

The shift in “zero” balance values and the variability in 24-h urinary iodine excretion rate: findings from the iodine balance experiment in children

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Background and objectives: The iodine balance experiment is commonly used to determine the estimated average requirement (EAR) of iodine. The data on iodine balance experiments in Chinese children are scarce. This study aimed to conduct an iodine balance experiment in Chinese children and provide a scientific basis for children's iodine reference intake in China.

Methods: A three-day iodine balance experiment was conducted in three schools with 29 school-age children. All food and water ingested by the subjects were measured by the weighing method, and 24-h urine and feces were collected. Iodine intake and excretion were assessed.

Results: A nonlinear relationship between the 24-h urinary iodine excretion rate and iodine intake was found. The 24-h urinary iodine excretion rate tends to increase with increasing iodine intake when the iodine intake is lower than 89.6μg/d (β=1.81, 95 CI%=0.49, 3.13), and decreases significantly with increasing iodine intake when the iodine intake is higher than 89.6μg/d (β=-0.07, 95 CI%=-0.09, -0.05). We found that the "zero" balance values increase with iodine intake in the analyses of the simple linear model and the linear mixed-effects models. The corresponding "zero" balance values were 130μg/d, 147μg/d, and 232μg/d for iodine intake of 145μg/d, 191μg/d, and 495μg/d, respectively. The "zero" balance values for children aged 7-10 years and 11-12 years at appropriate iodine intake levels were 130μg/d and 140μg/d, respectively.

Conclusions: The use of the 92% 24-h urinary iodine excretion rate to extrapolate iodine intake is not uniform. The population iodine nutrition background needs to be considered. The "zero" balance values showed a tendency to shift with increasing iodine intake. The "zero" balance values obtained from iodine-appropriate children may be used as a safe recommended level of iodine intake.

Keywords: iodine balance study, 24-h urinary iodine excretion rate, "zero" balance value, children

Conflict of Interest Disclosure: The authors have no conflicts of interest to declare.

PAB(T1)-6

Associations between dietary practices and sleep measures during weekdays and weekends among preschool-aged children in Finland

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Background and objectives: The importance of sleep is an integral part of growth, development, restoration, and metabolism, particularly in young children. Healthier dietary practices have been associated with beneficial sleep outcomes and unhealthier dietary practices with poorer sleep outcomes. However, routines for both diet and sleep may differ between weekdays and weekends. This study aims to examine the weekday and weekend associations of fresh fruit and vegetable, sugar-sweetened beverage, and added sugar intakes with sleep measures among children.

Methods: This study included 3-6 year-old children with diet and sleep data from at least two weekdays (n=700) and one weekend (n=697) from the Increased Health and Wellbeing in Preschools (DAGIS) study. Consumption of fresh fruit and vegetables, sugar sweetened beverages, and added sugar was measured via 3-5 day (≧2 weekdays and ≧1 weekend) food diary, further divided into tertiles for analysis. Sleep was measured with 24-hour hip-worn accelerometers. For sleep, weekdays were Sunday-Thursday and weekends Friday-Saturday nights. Sleep measures included: adequate nighttime sleep (10-13 hours), later sleep onset (>21:00), and poor sleep quality (sleep efficiency <85%). Logistic regression analyses were adjusted for age, sex, parental education level, and energy intake.

Results: Only 29-43% (weekday-weekend) of preschoolers had adequate sleep, 59-75% had later sleep onset, and 25-29% had poor sleep quality. Compared to children with low consumption, children with high consumption of fresh fruit and vegetables on weekdays had decreased odds of having a later sleep onset (OR: 0.67 (95% CI: 0.46, 0.98)) and poor sleep quality (OR: 0.61 (95% CI: 0.39, 0.94)) on weekday nights. Similarly regarding weekdays, children with higher added sugar intake had increased odds of having a later sleep onset (OR: 1.56 (95% CI: 1.05, 2.34)). No statistically significant associations were observed between sleep and diet on weekends or sugar-sweetened beverages on weekdays.

Conclusions: Poor sleep was prevalent among preschoolers and associated with more unfavorable dietary practices on weekdays. Increased fruit and vegetable consumption and reduced added sugar intake may be beneficial for sleep onset and quality. Further investigations into the differences and direction of the associations between diet and sleep on weekdays and weekends are warranted.

Keywords: food intake, sleep quality, sleep timing, childhood nutrition, actigraph sleep

Conflict of Interest Disclosure: N/A

Further Collaborators: DAGIS research group

PAB(T1)-7

Protective effects of Sulforaphane on Heart Rate Variability upon calorie-induced inflammatory response: A double-blind, crossover, randomized, placebo-controlled study

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Background and objectives: Most non-communicable diseases are partially affected by chronic low-grade inflammation (CLGI). Several bioactive compounds found in fresh fruits and vegetables have been described as anti-inflammatory ingredients, of which sulforaphane (SFN) shows the most promise for clinical testing due to its absorption and metabolism into human tissues and effects on health and specifically CLGI. Heart rate variability (HRV) is a reliable index of cardiac vagal regulation and should be inversely related to levels of inflammatory markers. We have studied the potential beneficial physiological effects of SFN, assessed by HRV parameters, in the setting of a calorie-induced inflammatory response in healthy participants.

Methods: The study was designed as a double-blind, crossover, randomized, placebo-controlled intervention study. On two separate testing days, twelve healthy participants (18-50 years old) received either 16 grams (intervention) of broccoli sprouts (BroccoCress®) or 16 grams of Affilla Cress® (placebo) in randomized order. After 90 minutes, participants received the 'PhenFlex' challenge, a standardized high-fat, high-sugar, and high-calorie drink. On four different time points, HRV parameters were assessed in short term (5 min) ECG recordings obtained in supine position and analyzed as recommended by clinical standards (ESC / NASPE, 1996). Total power, high-frequency power, low-frequency power, and very low-frequency power were derived from the spectral analysis, together with different time-domain indices. The recordings of ECG were performed four times: (i) before administration of investigational product; (ii) before administration of PhenFlex; (iii) 30 min after administration of PhenFlex; (iv) 2 hours administration of PhenFlex.

Results: The first results indicate that sulforaphane has a positive effect on several HRV parameters and that there appears to be a protective effect against the standardized PhenFlex challenge. Preliminary trend analyses indicate that after consumption of BroccoCress®, participants have a higher HRV, devoted to overall better health.

Conclusions: The findings from our study indicate that sulforaphane may have a protective effect on inflammation induced by the standardized PhenFlex challenge, which mimics exposure to CLGI, as measured by HRV parameters. Sulforaphane consumption could thereby elicit a beneficial physiological effect and thus have a health-promoting effect on non-communicable diseases.

Keywords: Nutrition, Sulforaphane, Inflammation, Heart Rate Variability, Non-communicable diseases

PAB(T1)-8

Effect of early iron supplementation in breastfed infants living in rural West Africa: a double blinded randomised controlled trial

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Background and Objectives: Recent evidence from the Gambia suggests that the supply of iron to growing tissues, including the brain, is insufficient during the first 6 months of life in breastfed infants. The primary objective of this study was to measure the impact of daily iron supplements for 98 days starting at six- to ten- weeks of age on iron status in infants living in rural Gambia. The study will also determine if iron supplementation at this age will impact on the frequency of adverse events.

Methods: This was a double-blinded randomised controlled trial. One hundred and one participants were recruited and randomised to either intervention (daily 7.5mg of elemental iron as ferrous sulphate) or placebo. Healthy infants (6-10 weeks old of age) were identified and enrolled if informed consent was obtained, they were healthy, exclusively breastfeeding and willing to stay in the study area. Participants planning to use commercial formulas or herbal supplements and those with fever, acute or chronic diseases were excluded. Venous blood and faecal samples were collected for baseline and endpoint evaluation. Participants were followed and supplemented daily for 98 days. Daily morbidity and weekly feeding questionnaires were completed. On days 0 and 99, 3ml of venous blood and faecal sample were collected for laboratory evaluation. Participants were followed to day 112 to monitor for adverse events.

Results: The trial has been completed. Analysis is ongoing and full trial results will be presented at the meeting. Results to be included will be serum iron concentration at Day 99 (after 98 days of iron supplementation and a day wash-out period), haemoglobin, MCV, reticulocyte haemoglobin, reticulocyte number, immature reticulocytes fraction, soluble transferrin receptor, ferritin, transferring saturation, erythroferrone, erythropoietin, and hepcidin concentrations, as well as illnesses/adverse events.

Conclusion: This trial will determine if the critically low levels of circulating iron observed in African children by mid-infancy should be improved by introducing iron supplements much earlier than currently recommended whilst babies are still breastfeeding.

Keywords: Iron, breastfeeding, anaemia, erythroferrone, erythropoietin

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-9

Nutrigenetic intervention for reducing body fat and blood lipids in adults with obesity and overweight: A randomised controlled trial

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Background and objectives: Obesity and dyslipidemias are risk factors for developing cardiovascular diseases. Pathogenesis involves environmental and genetic factors. There are several polymorphisms related to lipid metabolism alterations. Nutrigenetics studies the genetic variants' influence on the physiological processes promoted by foods to provide personalised dietetics guidelines. The objective of this study was to evaluate the effect of a nutrigenetic intervention on blood lipids levels and body composition of adults with obesity and overweight.

Methods: We selected eleven genetic variants associated with dyslipidemias in Mexicans, finding nutrigenetic recommendations for these polymorphisms. For the clinical trial, we included 101 adults with obesity or overweight and allocated them randomly into two arms considering genotyping, 1) standard diet (according to the WHO) and 2) nutrigenetic diet. We followed the participant for eight weeks and evaluated total cholesterol, HDL, LDL, VLDL, triglycerides, glucose, insulin, C reactive protein, as well as anthropometric measurements and body composition. We conducted the interviews remotely via virtual platforms.

Results: 46% (n=46) participants were obese, and 54% (n=55) overweight, by the end of the intervention 35% (n=35) presented obesity whilst 53% (n=54) overweight, and 12% (n=12) normal weight. We observed an improvement in biochemical parameters such as total cholesterol ($p<0.001$), VLDL ($p<0.001$), triglycerides ($p=0.002$), glucose ($p<0.012$), and insulin ($p=0.002$). Although we did not observe a statistical difference between study groups, all participants improved their body composition, weight, and biochemical indicators. There is a clear statistical tendency in the nutrigenetic arm to have better results when compared to the standard diet group.

Conclusions: The present nutrigenetic intervention was able to improve lipid abnormalities in patients with excess weight. Therefore, this strategy could reduce the risk of cardiometabolic diseases such as dyslipidemia, and as a coadjuvant strategy to standard treatments.

Keywords: Nutrigenetics, Dyslipidemia, Nutritional genomics, Obesity, Cardiometabolic risk

Conflict of Interest Disclosure: The authors declare that there is no conflict of interest to be disclosed. The State Council of Science and Technology (COECYTJAL) funded this project.

Further Collaborators: Naomi Pérez-Naitoh, Leonardo Leal-Mercado, Alondra Mora-Jiménez, Laura Arellano.

PAB(T1)-10

Effect modification by metabotype in an EWAS of usual dietary food consumption

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Background and Objectives: Different metabolic states may effect associations between diet and DNA methylation. This can be captured by metabotypes, clustered subgroups with metabolically homogenous profiles. Our aim was to examine the effect modification by metabotype between habitual consumption of various food groups and white blood cell DNA methylation.

Methods: Habitual dietary intake was estimated based on repeated 24-hour diet recalls and a food frequency questionnaire in participants of the population-based KORA FF4 study. Residuals of energy-adjusted food group intake data were used in this epigenome-wide association study [EWAS]. DNA methylation was measured using the Infinium MethylationEPIC BeadChip providing data on >850 000 loci. Using four standard clinical parameters and BMI, three metabotype clusters were identified by the K-means clustering procedure. The final study sample comprised 1261 participants. Confounder-adjusted linear regression models were used to test for effect modification by metabotype between diet and DNA methylation.

Results: Many significant hits were observed in models including food group-metabotype interaction terms, e.g. >80 hits for cheese and margarine consumption, respectively. Most findings refer to effect modification of food intake (e.g., cheese, whole-grain products, margarine) by metabotype 3, which is the metabotype with the most unfavorable metabolic profile. Many of the significant CpG's in this EWAS could be annotated to genes, which will be interpreted in the context of the study aims.

Conclusion: This research emphasizes the importance of including metabolic information of subjects when identifying associations between diet and white blood cell DNA methylation in EWAS. However, replication in future studies is needed.

Keywords: EWAS, Metabotype, Effect Modification, Food groups

Conflict of Interest Disclosure: No conflict of interests to disclose

Further Collaborators: None to declare

PAB(T1)-11

A digitally delivered diet and lifestyle intervention to support African and Caribbean migrants in the UK: Results of a 6 months Pilot Study.

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Background and Objective: Weight loss interventions are often not effective among migrant populations. The objective of this study was to evaluate a 6-month digitally delivered culturally adapted diet and lifestyle pilot intervention to support African and Caribbean migrants living in Greater Manchester, United Kingdom.

Methods: Intervention design was pre-post design, and was delivered digitally over 24 weeks. Participants who met the intervention inclusion criteria i.e., lived in Greater Manchester, identified themselves as being of African or Caribbean origin, and 18 years and over, were invited, via social media, to participate. Participants received tailored nutrition and health education, and participated in healthy cooking lessons/demonstrations every Tuesday for 90 minutes over 24 weeks (November 2021-March 2022). On a daily basis, participants interacted by sharing photos of their meals, asking questions and sharing experiences of dietary changes on a WhatsApp platform. Participants also participated in daily 10,000 steps challenge as part of the intervention package, which was monitored using a fitness mobile application. Group discussions (24) involving 20-30 participants helped to explore the views of participants regarding the potential impact of the interventions.

Results: Ninety percent of the participants were females. Africans constituted the majority (86%), and most (78%) had tertiary level education. Over half (57%) were in full-time employment whilst 6% and 12% identified themselves as either housewives or students respectively. 22%, 10% and 4% respectively reported that they have high blood pressure, high cholesterol, and diabetes. At baseline, 32% of the participants were engaged in moderate exercise, and 26% had no exercise plan. Daily fruits and vegetables consumption, was on average less than 3 portions per day, half of the recommendation by UK Eat Well guide, whilst the consumption of processed foods was habitual. After 6 months, intervention participants reported modifications in dietary habits: increased consumption of fruits and vegetables, reduced intake of processed and sugar-sweetened beverages, weight loss, increased daily level of physical activities and feeling healthier.

Conclusion: A digital community tailored lifestyle intervention has the potential to result in dietary behavioural and physical activity modification among Africans and Caribbean migrants living in Greater Manchester communities. A randomised controlled trial is recommended to further test this.

Keywords: African Migrants, Lifestyle Intervention , Weight Loss , Dietary Behaviour , Physical Activity

Conflict of Interest Disclosure: No

PAB(T1)-12

Impact of omega 3 incorporation on the functionality of high-density lipoprotein: Randomized, parallel and controlled clinical trial

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Background and objectives: The antiatherogenic role of high-density lipoprotein (HDL) is related to reverse cholesterol transport (RCT), however recent studies show additional function to HDL. Here, our goal was to evaluate the impact of ω-3 on the fatty acid profile, size and antioxidant capacity of HDL.

Methods: A randomized, controlled, double-blind, parallel clinical study involving 147 adult subjects with cardiovascular risk factors allocated into the ω-3 group (n=77; 3.0 g/day containing 1.8 g EPA + DHA) or the ω-6 group (n=70; 3.0 g/day of sunflower oil containing 1.95 g of linoleic acid). In the beginning (T0) and after 8 weeks (T8) blood samples were collected and, from plasma or serum, were analyzed lipid profile (TC, HDL-C, LDL-C, TG), apolipoproteins AI, CII and CIII, HDL subfractions (Lipoprint®), paraoxonase (PON1) and cholesterol ester carrier protein (CETP) activities, antioxidant capacity of HDL (experimental method), the fatty acid profile and NEFAs content HDL.

Results: The ω-3 and ω-6 groups were similar in relation to age, sex, smoking and medication use, both presenting high prevalence of hypertension and dyslipidemia. In both groups, there was a reduction in all lipid markers except HDL-C concentration, which increased. The effect of time on HDLNEFAs content (Δ=-16.2%), and on the percentage of HDLLARGE (Δ=20.1%) and HDLSMALL (Δ=-5.0%) were observed. Increasing EPA in HDL was associated with a lower chance of enhance PON1 activity (OR=0.446, CI=0.200-0.994), HDLNEFAs concentration (OR=0.275, CI=0.113-0.660), and HDLSMALL (OR=0.337, CI=0.146-0.782). It was also observed that EPA was associated with approximately 3.5 more chances of raising the percentage of HDLLARGE (OR=3.522, CI=1.652-7.507). Increasing DHA in HDL was significantly associated with a decrease in Apo AI concentration (OR=0.351, CI=0.150-0.821), and also PON1 activity (OR=0.226, CI=0.110- 0.639) and concentration of HDLNEFAs (OR=0.275, CI=0.113-0.668). Similar results obtained with EPA were observed for DHA and HDL size. No effect of the incorporation of EPA and DHA on oxidation resistance was observed.

Conclusion: The ω-3 intervention promoted changes in the composition of the HDL particle, increasing the percentage of the larger subfractions, without, however, modifying its antioxidant capacity.

Keywords: High-density lipoprotein, Particle size, Omega-3, Oxidation

Conflict of Interest Disclosure: No competing interests

PAB(T1)-13

Biochemical Characterization and Analyses of Red Meat Derived sialic acid glycans in different animal species for human health

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Red meat is a good source of protein, iron, B12, zinc, creatine and other nutrients for human nutrition. However, an increasing number of studies show a relationship between the consumption of the red meat-derived, non-human Sia, N-glycolylneuraminic acid (Neu5Gc), and inflammation, cancer progression, cardiovascular disease, and several autoimmune diseases. The level of Neu5Gc in skeletal muscle and organs across animal species remains unknown. We measured Neu5Gc in skeletal muscle and organ tissues from nine animal species using UHPLC. We found that Neu5Gcconcentration in skeletal muscle was the highest in goats (166 ± 48.7 μg/g protein), followed by cattle, pig, sheep, horse, cat and deer. Interestingly, no Neu5Gc was detected in kangaroo and dog muscles. More than 70% Neu5Gc was in the conjugated form. Total Neu5Gc in organ meats was generally about 2- 54% higher than in muscle. Surprisingly Neu5Gc was absent in seven organs of female deer. Similar levels of Neu5Gc were expressed across 9 primal commercial cuts of sheep meat. In conclusion, red meat Neu5Gc expression is species-specific, and absent in some organ and muscles meat. Low expression of Neu5Gc in skeletal muscle and its absence in kangaroo, dog and in all female deer organs suggest that these meats are the most appropriate for human consumption to avoid adverse health outcomes. Our study provides guidelines for the selection of animal meat products for consumers to prevent inflammatory disease and cancer progression.

Keywords: Sialic acid; N-glycolylneuraminic acid (Neu5Gc); muscle & organ tissue; , animal species

Conflict of Interest Disclosure: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this abstract.

Further Collaborators: The authors would like to greatly thank Sandra Diaz, University of California, San Diego, for her valuable suggestion regarding the sample preparation method used in this study. Our appreciation also extends to Joe Price, senior technical officer at Pre-Clinical Centre, CSU and his team (Felicity and Kate) for their kind assistance in the sample collection.

PAB(T1)-14

Association of low serum levels of long chain saturated fatty acids with cancer: A nested case-control study

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Background and objectives: Recent studies have implicated impaired epidermal barrier function in cancer. The epidermis is rich in ceramides, important precursors of sphingolipids, which maintain the barrier function of the epidermis. Saturated and monounsaturated C16-C24 fatty acids are the main components of ceramides. However, differences in fatty acid profiles that are important for skin barrier function have not yet been explored between cancer patients and healthy individuals. We aimed to investigate the relationship between serum fatty acids and cancer.

Methods: We conducted a nested case-control study of 43 cancer cases and 43 controls matched by age, among Japanese men who were a part of the Takashima Cohort Study. We collected one 0.5 mL fasting blood sample from each participant into a sodium heparin vacuum collection tube. Serum fatty acid concentration was measured by gas chromatography and presented as a percentage of total lipids by weight. We performed the Spearman rank correlation test to examine the correlation between fatty acids. Logistic regression models were used to evaluate the association between fatty acids and a positive history of cancer, adjusting for age, body surface area, energy intake, smoking, alcohol consumption, and physical activity.

Results: Total serum fatty acid concentration did not differ significantly between men with and without cancer. Palmitic acid (C16:0) and palmitoleic acid (16:1n-7) were strongly positively correlated with each other and negatively correlated with long-chain fatty acids such as arachidic acid (C20:0), behenic acid (C22:0), and lignoceric acid (C24:0). Cancer patients had higher levels of palmitic acid (C16:0) and palmitoleic acid (C16:1) and lower levels of arachidic acid (C20:0), behenic acid (C22:0), and lignoceric acid (C24:0) than the controls.

Conclusions: This study suggests that a low level of serum long-chain saturated fatty acids, which are important components for maintaining skin barrier function, may be associated with cancer.

Keyword: cancer, ceramide, serum fatty acid, very long chain saturated fatty acid, nested case-control study

Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-15

Transient and eminent decrease in red blood cell copper (RBC-Cu) during metabolic studies in young Japanese females

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Background and objectives: Roles of RBC on mineral metabolism have not been clarified. Transport mechanisms of Cu are not fully recognized as well.

Methods: Blood was sampled 3 or 4 times in the morning with 3 to 4 days interval at human mineral balance studies conducted by the National Institute of Health and Nutrition. Hematocrit (%), serum (S-) and RBC-Cu were measured by atomic absorption spectroscopy (AAS), after deproteinization of S- and RBC- samples by 0.5 mM nitric acid solution as well as after wet ashing by nitric acid and hydrogen peroxide solution, then calculated RBC-Cu in 41 female and 19 male subjects.

Results: Data by the deproteinization and by the wet ashing were essentially the same. S-Cu and RBC-Cu in female subjects by the deproteinization method at the initial day (mean ± S.D.) are 1.04±0.14, and 0.56± 0.38 (mg/ L), respectively. Correlation between S- and RBC-Cu is not significant, although those in iron (Fe) and zinc (Zn) are positively significant. RBC-Cu showed transient and eminent decrease during the balance studies in most cases in females, while in few cases in males.

Discusion: RBC-Cu showed typical transient changes in females, suggested a transient decrease related to the menstruation cycle. RBC-Cu may invade into mucosa in uterus, facilitate defluxion of the mucosa. Though chemical form of RBC-Cu is not determined, it has some possibility to be something other than ceruloplasmin. Further investigations are needed to reveal the fine mechanism of RBC-Cu, and the relation between menstruation and RBC-Cu.

Conclusions: Transient decrease in RBC-Cu was eminent in female subjects, and we discussed the physiological roles of this phenomenon in the menstruation cycle.

Keyword: Brown fat, energy expenditure, food ingredients, non-shivering thermogenesis, obesity

Conflict of Interest Disclosure: none

PAB(T1)-16

Relationship between serum 5-methyltetrahydrofolate status and one-carbon metabolism-related metabolites in young women

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Background and objectives: One Carbon Metabolism (OCM) consists of the folate cycle and choline metabolic pathway connected to the methionine cycle, and homocysteine (Hcy) in the methionine cycle is partially metabolized by the transsulfuration pathway. In this study, we comprehensively measured OCM-related metabolites in serum of women of childbearing age and investigated how serum 5-methyltetrahydrofolate (5-MTHF) concentrations are related to the choline metabolic pathway, methionine cycle, and transsulfuration pathway.

Methods: In this cross-sectional study, we recruited 227 young Japanese women. Serum concentrations of 18 OCM-related metabolites (5-MTHF, folic acid, choline, betaine, dimethylglycine, methionine, S-adenosylmethionine (SAM), S-adenosylhomocysteine (SAH), total Hcy (tHcy), homocysteic acid, cystathionine, total cysteine (tCys), taurine, serine, glycine, riboflavin, pyridoxine, pyridoxamine) were measured by LC-MS/MS. The association between the concentrations of OCM-related metabolites in serum were evaluated by Spearman's rank correlation coefficient. Serum 5-MTHF concentrations were stratified into two groups, low 5-MTHF group and high 5-MTHF group, based on median values.

Results: Serum 5-MTHF concentration showed a significant positive correlation with betaine in the choline metabolic pathway, SAM in the methionine cycle, and tCys in the transsulfuration pathway, respectively (ρ=0.25, ρ=0.14, ρ=0.15). In addition, 5-MTHF and betaine showed significant negative correlations with tHcy, respectively (ρ=-0.46, ρ=-0.29). Furthermore, when stratified by serum 5-MTHF concentration, the correlation coefficient between 5-MTHF and tHcy was p=-0.38 and betaine and tHcy was p=-0.10 in the high 5-MTHF group. In contrast, in the low 5-MTHF group, the correlation coefficient between 5-MTHF and tHcy was p=-0.36 and betaine and tHcy was p=-0.40. The negative correlation between betaine and tHcy was stronger in the low 5-MTHF group than in the high group.

Conclusions: The results of this study suggest that 5-MTHF status and the metabolic dynamics of the choline metabolic pathway, methionine cycle and transsulfuration pathway may be linked. Although tHcy is remethylated and reduced by 5-MTHF or betaine, respectively, the strength of the correlation indicates which substance is responsible for the remethylation. Our study suggests that tHcy remethylation by betaine may be enhanced in the low 5-MTHF state.

Keyword: One-carbon metabolism, 5-methyltetrahydrofolate, Betaine, S-adenosylmethionine, Transsulfuration pathway

Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-17

Relationship between a body shape index with traditional cardiovascular risk factors in Peruvian adults: Analysis of cross-sectional study

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Background and objectives: cardiovascular diseases present traditional risk factors such as obesity, abdominal obesity (AO), dyslipidemia, type 2 diabetes mellitus, hypertension, and non-traditional risk factors such as the A Body Shape Index (Absi). Absi was proposed for the estimation of abdominal adiposity. In Peru, obesity rates and AO are current problems in young adults. We evaluate the relationship between Absi and each traditional cardiovascular risk factor in Peruvian adults in 2017.

Methods: one hundred voluntarily adults participated. The WHO STEPwise Approach to Non-Communicable Diseases Risk Factor Surveillance (STEPS) method was used to assess behavioral risk factors: tobacco use (active/no), alcohol use (use/no), physical activity (sedentary/non-sedentary), unhealthy diet (yes/no) as well as biological risk factors: obesity, AO, raised blood pressure, raised blood glucose, and abnormal blood lipids such as triglycerides, and total cholesterol. Absi was determinate using the formula: waist circumference (WC) / [(BMI 2/3) * (height 1/2)], both WC and height measured in meters. The association between Absi and each risk factor was evaluated by bivariate analysis. For numeric variables, we used Pearson correlation and Spearman correlation, and for categoric variables, chi-square test with a significance level of 5%.

Results: The average age was 46,1 ± 9.78 years and 66% were women. Obesity according to BMI was 23% and 41% have a very high cardiovascular risk according to WC, both indicators were higher in women than in men. The average Absi was 0,0817 ± 0,0031 m11/6 kg2/3 for men and 0,0792 ± 0,0045 m11/6 kg2/3 in women. 91% were moderate physical activity or sedentary and 44% have total cholesterol above 200 mg/dl. Absi and WC presented a positive-moderate association (Pearson correlation coefficient (r)= 0.431, p <;0.0001), the association was decreasing with triglycerides in mg/dl (r= 0.142), total cholesterol in mg/dl (r= 0.089) and blood glucose g/dl (r= 0.047). Absi and BMI presented a non-significant inverse relationship (r= -0.089). Tobacco use, alcohol use, unhealthy diet, and physical activity do not present a statistically significant association.

Conclusions: Absi has a direct relationship with WC; therefore, it's coherent with the literature. But doesn't exist relationship with the other cardiovascular risk factors in Peruvian adults.

Keyword: Obesity abdominal, Body composition, Anthropometric measure, Cardiovascular diseases risk factors

Conflict of Interest Disclosure: none

PAB(T1)-18

Dietary wheat proteins worsen gastrointestinal symptoms in healthy vegetarians.

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Background and objectives: The popularity of a plant based (PB) diet has recently increased in Western countries, mostly driven by concerns about animal welfare / sustainability, and the alleged health benefits. However, the consumption of wheat proteins, key component of a PB diet, have been linked to gastrointestinal inflammation and exacerbation of gastrointestinal (GI) symptoms. Therefore, we would like to evaluate the effect of dietary wheat proteins on GI symptoms and quality of life in healthy vegetarians and omnivores.

Methods: We asked 24 healthy participants (8 vegetarians and 16 omnivores) to reduce their consumption of gluten by at least 70% for 2 weeks. Dietary information, gastrointestinal symptoms, and quality of life were collected before and after the intervention via self-administrated validated questionaries, namely: food diaries, digestive symptoms frequency questionnaire (DSFQ) and a 12-Item Short Form Survey (SF-12).

Results: Participants were mostly females (66%), the mean age was 24.9 ± 8.4 years and consumption of gluten was reduced by ~80% among vegetarians and ~90% among omnivores, during the intervention period. No differences were observed in dietary intake, gastrointestinal symptoms (DSFQ) or physical / mental quality of life (SF-12) among omnivores. However, vegetarians reported a significant reduction (P<;0.05) in gastrointestinal symptoms after 2 weeks on a reduced gluten diet, without affecting quality of life or nutritional status.

Conclusions: Our study suggest that the gastrointestinal health of vegetarians would improve by reducing the consumption of wheat proteins without affecting quality of life. Nevertheless, further studies are needed to confirm these results and to investigate the role of plant proteins on gastrointestinal health.

Keyword: plant-based diet, wheat proteins, gastrointestinal health, quality of life

Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-19

Regional mean values for biomarker data from a national-scale survey: estimates, predictions, and their interpretations

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Background: Globally, billions suffer micronutrient deficiencies, with about 31% suffer Zinc deficiency (WHO). Periodic multistage national scale surveys that use unequal inclusion probabilities at different stages monitor populations' micronutrient status. We use sampling weights that account for the population fraction represented by each stage to calculate design-unbiased population estimates. These estimates become biased if changes are made to sampling practice during the survey so that the original inclusion probabilities no longer hold (e.g., Ethiopia Micronutrient Survey, 2016).

Objective: How to use a linear mixed model (LMM) for population estimates from national-scale surveys that departed in practice from the original sample plan.

Methods: A LMM with a proposed covariance structure which reflected the sample – individuals nested within households (HHs), HHs within enumeration areas (EAs), EAs within regions – for making unbiased population zinc deficiency estimates. Regions specified fixed, and EAs and HHs specified random because all regions were sampled while EAs and HHs were randomly sampled. The prediction of the mean for an unsampled EA or HH, within a sampled region is equal to the estimated mean for that region. However, predicted mean values of EAs and HHs have larger uncertainties than the estimated regional means. Because predictions have uncertainties, true values of predictions that exceed a threshold may have zero probabilities of exceeding the threshold, and vice versa. Consequently, probabilities that measure the likelihood that a prediction of an unsampled unit (e.g., EA) falls below a specified threshold are preferred for policy decisions. The probabilities are communicated using the Intergovernmental Panel on Climate Change's calibrated phrases: <; 0.01, exceptionally unlikely; <; 0.33, unlikely; ≧ 0.66, likely; ≧ 0.9, very likely; and ≧ 0.99, virtually certain.

Results: EAs in Addis Ababa region were unlikely to have Zinc deficiencies. EAs in Amhara, Afar, Benishangul-Gumuz, Dire Dawa, Gambella, Harari, Somali and Tigray were likely to have deficiencies, and EAs in Oromia and SNNPR were very likely to have deficiencies.

Conclusion: We correctly specified the covariance structures of the LMM given the different probabilities of EAs within regions falling below the specified Zinc threshold (65 mg per kg).

Keyword: Linear mixed model, Probabilities, Threshold, design-unbiased estimates, National-scale surveys

Conflict of Interest Disclosure: none

PAB(T1)-20

Model and predictor ranking based on machine learning algorithms in application to childhood stunting in Popokabaka health zone (DRC).

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Background and objectives: The prevalence of childhood stunting in Popokabaka is quite high compared to country average. Many studies have been conducted in the last five years to investigate risk factors of stunting in this area. This study are based on conventional statistical approaches, which are constraints to different assumptions such as normality, sample size, linearity. However, the relationship between risk factors and stunting may not obey to these assumptions '. Machine learning and artificial intelligence algorithms have proven the ability to deal with complex data and has been widely used in different research areas, including public health. This research assesses the performance of the most advanced machine learning algorithms to model stunting and rank its risk factors in order of importance

Methods: We therefore tested random forest, artificial neural network, support vector machine and partial least square linear discriminant analysis. These algorithms were implemented and optimized in Python programming language. The observation was split into calibration (70 %) and validation (30%) datasets prior to analysis.

Results: Among these algorithms, support vector machine shows the lowest misclassification error (overall accuracy = 60 %, sensitivity = 0,27%, specificity = 0,85%), follow by random forest. The three most important variables (in order of importance) are the wealth quantile, the age and the health area.

Conclusions: machine learning algorithms may aid policymakers in reducing malnutrition in DRC.

Keyword: machine learning, variable selection, stunting

Conflict of Interest Disclosure: none

PAB(T1)-21

Utilization and acceptability of sorghum stem sheath extract and its potential contribution to micronutrient intake of women of reproductive age

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Background and objectives: The global trend of under-nutrition is increasing and simultaneously leads to hidden hunger and affects over 2 billion people, especially children and women of reproductive age (WRA). Dietary intervention is one of the micronutrient-specific interventions proven to help combat micronutrient malnutrition especially among WRA. Sorghum stem sheath the supposed farm waste extract has been research to be good source of vitamin and minerals coupled with its hematopoietic and anti-anaemic characteristics. This study assessed the utilization and acceptability of sorghum sheath extract and its potential contribution to the micronutrient intake of women of reproductive age.

Methods: A semi-structured, interviewer-administered questionnaire was used to elicit information socio-demographic characteristics, knowledge and utilization, frequency of consumption, and evaluation of the extract from about 150 respondents within the WRA age range from three wards in Ibadan Southwest Local Government area. To support the micronutrient need and preference of the women of reproductive age especially taste. The extract from sorghum stem sheath was spiced with ginger 1 %, clove 1 % and sweetened (sucrose and date palm). The extract was formulated based on the sample with the highest Iron and ß-carotene content from established methodologies of sorghum stem extract using the minitab software. The extracts were further subjected to organoleptic assessment among 40 panelist using the nine (9) point hedonic scale to determine the overall acceptability.

Results: Respondents age range 15 – 24 years had low knowledge of the extract despite its availability, low cost and accessibility. About 92 % of the respondents claim the extract to be blood booster and frequent use observed among older (44 – 49 years) while 90% of the preferred extract to supplement intake. The organoleptic characteristic of the extract with sucrose was the most acceptable. Further into the research, nutritional, anti-nutritional, antioxidant properties and contribution to nutrient intake were evaluated using standard method of analysis of AOAC. Statistical analysis showed differences among sweetened samples (p<;0.05). Beta carotene content with increase in nutrient concentration with addition of sweeteners.

Conclusion: The extract could be a good substitute for some carbonated drinks and source of micronutrients foe women of reproductive age.

Keyword: Women, Reproductive age, Micronutrient, Sorghum, Utilization.

Conflict of Interest Disclosure: none

PAB(T1)-22

Anemia, food security, and oyster consumption among women shellfishers in Ghana and The Gambia

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Background and objective: Oysters are rich in iron and their consumption may reduce food insecurity and anemia, however it is unknown to what extent oysters are part of the diet of women shellfishers. Our objective was to examine the associations between oyster consumption and food insecurity and anemia among women shellfishers.

Methods: From Feb-Jul 2021, we enrolled women shellfishers aged 15-49 in Ghana (n=504) and The Gambia (n=214) and used a repeat 24-hr recall to estimate average daily oyster consumption. We collected data on food security using the Household Food Insecurity Access Scale and hemoglobin (Hb) was assessed from a blood sample obtained by finger prick. Linear regression was used to examine the associations between oyster consumption, food security, and hemoglobin. Poisson regression was used to determine the risk of food insecurity and anemia (Hb <; 120 g/L) among women who reported not eating oysters compared with those who ate oysters.

Results: Only 7% of women in The Gambia and 11% in Ghana reported eating any oysters. Most women were experiencing some level of food insecurity (The Gambia: 83%, Ghana: 92%) and severe food insecurity was identified in 43% of women in The Gambia and 78% in Ghana. Anemia prevalence ranged from 20% in Ghana to 41% in The Gambia. In models adjusted for age, wealth index, education, BMI, and country, higher consumption of oysters was associated with lower Hb, although the impact was small; for every 10% increase in oyster consumption, Hb decreased by 0.04 g/L (p=0.037). Higher oyster consumption was not associated with food security (p=0.243). Eating oysters was not associated with either anemia risk [RR (95% CI): 1.05 (0.70,1.570)] or risk of food insecurity [0.76 (0.35, 1.67)].

Conclusions: Nearly half of women in The Gambia and most women in Ghana were experiencing severe food insecurity, however the proportion of women that ate oysters was very low in both countries. Overall, there was no association between oyster consumption and anemia and food security. Further research is warranted to understand the reasons women are not eating the oysters despite high food insecurity.

Keyword: Anemia, Food security, Ghana, The Gambia

Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-23

Comparison of the dietary factors affecting the enterotypes of gut bacteria in a Japanese cohort

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Background and objectives: Gut bacteria can be classified into three enterotypes, which is affected by lifestyle factors such as diet. The factors determining enterotype are believed to be cohort-dependent. In this study, we analyzed the relationships between dietary factors and enterotype in Japanese participants who consumed a traditional diet.

Methods: We conducted a cross-sectional cohort study of participants recruited at a food product company in Japan. We collected information about medical checkups and dietary habits using a questionnaire. Fecal bacterial composition was assessed using 16S rRNA amplicon sequencing, and enterotype was classified into three clusters using genus-level data. After adjustments for age, sex, and energy intake, we used logistic regression analysis to examine the association between enterotype and 26 dietary factors. Variance inflation factors were previously measured, and a variance greater than five was excluded from the model.

Results: The cohort of 256 participants (190 men and 66 women) had all three enterotypes (Bacteroides [n = 115], Faecalibacterium [n = 100], and Prevotella 9 [n = 41]). Participants with the Prevotella type had more lifestyle-related diseases, whereas those with the Faecalibacterium type had fewer lifestyle-related diseases. The Bacteroides type was negatively associated with the consumption of barley (10 g) (OR 0.90, 95% CI: 0.84–0.97) and ice cream (10 g) (OR 0.97, 95% CI: 0.95–1.00). The Faecalibacterium type was positively associated with the consumption of barley (10 g) (OR 1.10, 95% CI: 1.03–1.20). The Prevotella type was positively associated with the consumption of ice cream (10 g) (OR 1.02, 95% CI: 1.0–1.04), liver (10 g) (OR 1.50, 95% CI: 1.18–1.91), miso soup (10 g) (OR 1.01, 95% CI: 1.00–1.01), green tea (100 ml) (OR 1.04, 95% CI: 1.01, 1.07), and coffee (100 ml) (OR 1.04, 95% CI: 1.01–1.06). Dietary fiber intake was associated with Faecalibacterium type bacteria such as Faecalibacterium, Subdoligranulum, and Alistipes.

Conclusions: The Prevotella enterotype was associated with the greatest number of foods. The Bacteroides type was negatively associated with foods such as barley and ice cream. The Faecalibacterium type was associated with barley likely due to the dietary fiber it contains.

Keyword: enterotype, gut bacteria, Faecalibacterium, barley, dietary fiber

Conflict of Interest: T.M., S.M., and T.K. are employees of Hakubaku Co., Ltd. All other authors have no competing interest to declare.

PAB(T1)-24

Correlation of urinary equol with genetic markers constructed for equol-producing bacteria

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Background and objectives: Equol is a metabolite of soy isoflavone by intestinal bacteria and possesses higher estrogenic activity than other isoflavones. Equol is therefore thought to have a considerable impact on human health. The ability to produce equol depends on the individual's intestinal environment, especially the presence of equol-producing intestinal bacteria. Previously, we isolated an equol-producing bacterium, Eggerthella sp. YY7918, from human feces. We also analyzed whole genomic sequence of Eggerthella sp. YY7918 and identified three equol metabolism-related genes (EQLs coding daidzein reductase, dihydrodaidzein reductase, and tetrahydrodaidzein reductase). In this study, we constructed genetic marker for equol-metabolizing intestinal microbiota (EQL marker) and evaluated them in clinical specimens.

Methods: This study was conducted with the approval of the ethics committee of Gifu University (2018-114). The clinical specimens were collected as follows. Healthy adult women (age 19-71 n= 97) were given 50 mg of soy isoflavone for 2 days and fresh urine and feces were collected the next morning. After β-glucuronidase treatment and ether extraction, the urine was subjected to HPLC system. Fecal-derived DNA was subjected to a real-time PCR system using SYBR green. PCR primers were constructed from EQLs.

Results: Seven subjects were excluded due to a shortage of fecal specimens, and 91 were finally analyzed. Since the detection limit for urinary equol was 1,000 nM, we defined subjects with a urinary equol concentration >;1,000 nM as "equol producers". The number of equol producer and non-producer were 37 (41%) and 54 (59%), respectively. Thirty-two (86%) were EQL marker positive out of the 37 equol producers. While, 53 (98%) were the negative out of the 54 non-producers. EQL marker detected log105-8 copy / g feces in most equol producers (84%). The Pearson correlation coefficient between EQL marker and urinary equol quantity was 0.46. While the correlation coefficient between these two values was 0.05 when limited to the equol producers (n = 37).

Conclusions: EQL markers for log105-8 copy / g feces were detected in most equol producers. No correlation was found between urinary equol and the amount of EQL markers.

Keyword: equol, qPCR

Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-25

Lipid related genetic variants panel for precision nutrition interventions: a systematic review

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Background and objectives: Dyslipidemias represent an unfavorable prognostic factor for cardiovascular disease. It´s management includes pharmacological and dietary strategies which aim to maintain lipid profile within acceptable values. However, the response to diet can be influenced by the individual genetic background. Personalized nutrition interventions are designed according to key individual characteristics, such as their diet, phenotype, and genotype with promising results. However, it is not clear what are the exact genetic variants related to lipid metabolic abnormalities would help to design DNA-based dietary interventions for dyslipidemias. Therefore, the objective in the present study was to define a panel of genetic variants associated with lipid abnormalities that could be later used in nutrigenetic intervention studies.

Methods: A comprehensive systematic review was conducted following the PRISMA-Protocol. Studies published from January 2010 to December 2020 only in English language and human species were included from PubMed and ScienceDirect databases. Articles that demonstrated a strong association between polymorphisms of genes involved in lipid metabolism and increased risk of dyslipidemia were included.

Results: 3031 articles were identified, but only 54 articles fulfilled the inclusion criteria established on the systematic review protocol. The selected articles were organized according to the related lipid trait. The identified lipid related genetic variants were related to chylomicron synthesis and secretion, triglyceride hydrolysis, lipoprotein metabolism, and lipid clearance.

Conclusions: In this systematic review key lipid related genetic variants demonstrated strong association to lipid abnormalities. These variants can be used to design precision nutrition interventions that may help to effectively prevent and treat dyslipidemia. Specifically, could help to personalize dietary fatty acids quality and quantity according to their individual genetic background.

Keyword: Dyslipidemia, Genetic variants, Lipid metabolism, Precision nutrition

Conflict of Interest Disclosure: none

PAB(T1)-26

Can we influence gut bacteria and their metabolites by diet and resistance exercise in older people?

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Background and objectives: Human gut bacteria and their metabolites are potentially important for healthy human aging. Previous studies have indicated that diet and physical exercise can modify gut bacteria composition in older people. However, the effects of specific macronutrient changes as well as the potential effects of resistance training are currently understudied.

Methods: In a one-year parallel intervention study, 208 older Danish men and women (+65 years) were randomized to receive either 40 gram of maltodextrin, collagen or whey protein per day. Study subjects receiving whey protein were further divided into either heavy resistance training, light resistance training or no training. Six and 12 months changes in gut bacteria and fecal metabolites where investigated by 16s rRNA gene amplicon sequencing and proton NMR, respectively. Intervention-dependent changes in gut bacteria and metabolites were analyzed via PERMANOVA.

Results: In total, 184 subjects completed the intervention. Our results showed that gut bacteria as well as gut metabolites responded differently depending on the carbohydrate or protein interventions. Particularly the ingestion of collagen-derived protein affected gut bacteria composition (mostly within the Lachnospiraceae family) as well as metabolites related to protein metabolism in the gut of study subjects. Heavy, but not light intensity resistance training had minor effects on gut bacteria and their metabolites. Effects of heavy resistance training were primarily seen within Bacteroides as well as within metabolites associated with carbohydrate metabolism in the gut. In general, the observed effects of heavy resistance training were smaller than those observed for the dietary (macronutrient) interventions.

Conclusions: Our results suggest it is possible to modulate gut bacteria and their metabolic products via specific macronutrient changes to the diet of older humans. Resistance training has smaller effects on gut bacteria composition compared to dietary changes. Furthermore, it is likely that older people are required to engage in frequent and intensive physical training in order to see effects on gut bacteria.

Keyword: Nutrition, Exercise, Gut bacteria, Gut metabolites, Healthy aging

Conflict of Interest Disclosure: none

PAB(T1)-27

Habitual intakes of arabinoxylan and associations with gut microbiome composition in the ZOE PREDICT study

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Background and objectives: The dietary fibres arabinoxylan (AX) are non-cellulosic polysaccharides of primary and secondary cell walls found in cereals and grasses. Supplementation with AX has beneficial effects on microbiome species as well as multiple health benefits including increased satiety, cholesterol-lowering activity, reduced type 2 diabetes risk and immunomodulatory activity. However, habitual intakes and the effects when consumed naturally through foods have yet to be elucidated.

Methods: In the PREDICT 1 UK cohort (n=1,001), demographic information, habitual diet (EPIC Food Frequency Questionnaire), and microbiome samples (shotgun metagenomics) were assessed. AX concentrations were estimated from each fibre (non-starch polysaccharides (NSP)) containing food (using pre-published concentrations or extrapolated using monosaccharide (arabinose and xylose) contents) and habitual intakes (grams per day) estimated per participant. Associations between AX, fibre intakes, gut microbiome species (relative abundances) and cardio-metabolic health outcomes were examined.

Results: Mean fibre intakes (NSP) were 17.0±6.6g and AX intakes were 3.3±1.6g (Q1; 2.2g vs Q5; 4.1g). High AX (Q5) versus low AX (Q1) consumers had a lower BMI (by 1.8 kg/m2), visceral fat mass (by 81 g) and higher diet quality (healthful Plant based Diet Index (hPDI) by 3.1). Similar size effects were also observed for high and low total fibre intakes (Q5 vs Q1; BMI by 1.3 kg/m2, visceral fat; 74 g and hPDI; 6.1) and differences in body composition (AX and fibre) were lost after adjustment for diet quality. Foods with the highest contribution to total AX were grain-based, including high fibre cereals (22%), wholemeal pasta (12%), wholemeal bread (10%), muesli (9%) and porridge (7%). AX was strongly correlated with fibre intakes (r; 0.84, 95% CI; 0.81-0.85), however different gut microbiome species were independently associated with AX and not total fibre, including Bifidobacterium adolescentis, Bifidobacterium longum and Roseburia intestinalis species (previously associated with favourable health outcomes).

Conclusions: This study reports habitual dietary AX intakes in a healthy population, Bifodobacteria species, previously shown to increase post AX supplementation, were associated with higher habitual dietary intakes suggesting that dietary AX may favourably influence the microbiome.

Keyword: Arabinoxylan, Microbiome

Conflict of Interest Disclosure: none

Funding: ZOE Ltd, TDS, JW and GH are co-founders of ZOE Ltd (ZOE)

PAB(T1)-28

The association of ICAM1 gene rs5498 (A>;G) polymorphism, nutritional status and cardiovascular diseases susceptibility on dyslipidemia in Thai population

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Background and objectives: Atherosclerosis is a significant condition to develop cardiovascular diseases (CVDs). The CVDs risk factors included age, gender, food habit, dyslipidemia, obesity, and genetic variation. The intercellular adhesion molecule 1 (ICAM1) gene variant is announed to associate with CVDs progress. However, the impact of the ICAM1 rs5498 polymorphisms on dyslipidemia has not been reported. Therefore, we determine the relationships between single nucleotide polymorphisms (SNPs), including rs5498 on ICAM1 gene and CVDs susceptibility in patients with dyslipidemia.

Methods: The participants were classified as having dyslipidemia; dyslipidemia (n=135) or not (n=143). Food consumption pattern was determined using the semi-food frequency questionnaire (semi-FFQ). ICAM1 SNPs Genotyping was performed by DNA sequencing.

Results: Dominant model rs5498 participants had twice the risk of dyslipidemia (95% confidence interval (CI): [1.24–3.23], P = 0.005). The G allele frequency in rs5498 was 1.69 times higher in participants with dyslipidemia than in controls (95% CI [1.15–2.47], P = 0.007). Participants with the rs5498 AG or GG variants and those with a high LDL-C concentration (≧ 3.36 mmol/L) had 2.09 times the risk (95% CI [1.19-3.66], P = 0.010) of developing CVDs compared with those with low LDL-C levels. Participants carrying the rs5498 AG or GG variants who had tachycardia (resting heart rates (RHRs) >; 100 beats/min) had a 5.02-times higher risk than those with a lower RHR (95% CI [1.35-18.63], P = 0.016). Although, the amount of dietary intake between control and dyslipidemia group did not reach the statistically significant difference. However, the amount of energy intake, fat, and choresterol trend to higher in dyslipidemia group than those control group.

Conclusions: It may consider the robust of G allele in ICAM1 rs5498 is associated with a higher risk of CVDs susceptibility in Thai people with dyslipidemia and is also positively associated with LDL-C concentration, and RHR. This also showed that a food habit of dyslipidemia group trend to have a higher risk of CVDs than control. It might be possible that carrying of G allele, together with unhealthy consumption are co-risk factors to rapidly initiate CVDs.

Keyword: Intercellular Adhesion Molecule 1 Gene, Single Nucleotide Polymorphism, Gene variation, Dyslipidemia, Food habit

Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-29

True ileal digestibility of tryptophan in plant and animal source protein determined by dual isotope tracer technique in Indian adults

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Background and Objectives: Tryptophan (Trp), in addition to being an indispensable amino acid (IAA) for protein synthesis, is precursor of important bioactive molecules. Trp is present in sufficient quantities in plant and animal source protein to meet the daily requirement, but its digestibility is unknown in humans. The true ileal digestibility of Trp from any diet matrix is the sum of its digestion and absorption at the ileal level, which is relatively inaccessible. However, this can now be measured by the minimally invasive dual isotope tracer technique. The aim of the present study was to determine true ileal Trp digestibility in legumes and milk protein, in humans, by the dual isotope tracer technique.

Methods: The dual isotope tracer technique compares the ratio of plasma appearance of intrinsically (2H) labelled amino acid (AA) with respect to its enrichment in an ingested test meal to a similar ratio of a simultaneously ingested, but differently (13C) labelled, standard protein of known digestibility. This ratio of ratios provides a measure of true ileal AA digestibility. These AA enrichments were obtained in plateau feeding experiments in healthy adults. The true ileal digestibility of the reference Trp in U-[13C] spirulina (the standard protein) was first measured against a 2H labelled free Trp in an AA mixture. Subsequently, Trp digestibility was measured in intrinsically 2H labelled mung bean, dehulled mung bean, yellow pea, chickpea, and goat milk protein in comparison to reference Trp from U-[13C] spirulina or 13C labelled free Trp in an AA mixture (n=6 in each).

Results: The true ileal Trp digestibility (mean ± SD) of goat milk protein in comparison to 13C labelled free Trp was 93.6 ± 2.8%. Human plateau feeding studies to measure Trp digestibility of U-[13C] spirulina, mung bean, yellow pea, and chickpea have been completed earlier and measurements of Trp digestibility will be reported.

Conclusions: True ileal Trp digestibility of goat milk protein was within the range of reported true ileal IAA digestibility values of milk (90-100%).

Keyword: true ileal tryptophan digestibility, tryptophan, dual isotope tracer technique, plant protein, animal protein

Conflict of Interest Disclosure: none

PAB(T1)-30

Adherence to nutritional supplementation recommendations (ANSR) among women in low- and middle-income countries: A systematic review of behavioral and measurement issues

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Background and objectives: Micronutrient deficiencies among women of reproductive age (WRA) have been disproportionately represented in low- and middle-income countries (LMICs). Although nutritional supplementation is a known strategy for improving micronutrient status among WRA, evidence on intervention approaches and standardized measurement of adherence to nutritional supplementation recommendations (ANSR) is lacking. This systematic review aims to identify ways in which adherence to supplementation has been measured and assess intervention strategies to promote ANSR among WRA in LMICs.

Methods: Literature searches are currently being conducted in PubMed, Embase, and Scopus. Criteria for study inclusion and exclusion were developed by two researchers and finalized upon agreement among a team of four. Eligibility criteria include peer-reviewed research which: targets WRA in LMICs, evaluates an intervention providing nutritional supplements recommended by the WHO for pregnant women, includes implementation research components, and measures behavioral outcomes. Abstracts of all the retrieved articles are being independently screened by two reviewers, with a third reviewer to resolve conflicts.

Results: At present, 1,398 articles from PubMed underwent abstract screening. Of those, 151 were selected for full-text review. Searches using Embase and Scopus, followed by a full-text review and analysis is expected to be completed by September 2022. Preliminary results suggest there is little consensus on how adherence is defined and measured in the context of women's nutrition. Many behavioral trials don't explicitly measure adherence, assuming that those given supplements must have complied. Studies that measure adherence rely on self-reports or retrospective recall measures, and still others rely on third-party accounts. Additionally, the use of multiple modalities to assess adherence through triangulation was indeed rare.

Conclusions: Anticipated results of this systematic review will provide a landscape of the patterns and inconsistencies of adherence measurement among WRA across clinical trials, intervention evaluations, and nutritional-behavioral studies. The conclusions will provide guidance on feasible, cost-effective, and systematic ways of measuring ANSR. Moreover, results of this review will call attention to effective intervention strategies for facilitating ANSR to be applied to real-world settings. Recommendations will draw from diverse cultural, environmental, and social contexts to address a global concern in urgent need of forward thinking.

Keyword: Nutritional supplementation, Adherence, Women of reproductive age, Global health, Systematic review

Conflict of Interest Disclosure: none

PAB(T1)-31

Social jet lag and chronotype and its relationship with BMI in young people: a systematic review

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Background and objectives: The prevalence of overweight and obesity in young people has been dramatically suspected in recent years, one of the many reasons for this increase could be sleep disorders. Adolescence is a critical developmental period where sleep deprivation frequently occurs. For this reason, they sleep more on the weekend to compensate, which increases their social jet lag. Much of the existing evidence describes the relationship between sleep quality and body weight, but the relationship of chronotype and social jet lag with weight in this population group has not been extensively studied. The objective of this work was to systematize the scientific evidence on the relationship of social jet lag and chronotype with the body mass index (BMI) in young people.

Methods: Pubmed, EMBASE, and MEDLINE databases were searched for papers on social jetlag and chronotype and obesity, focusing on, adolescents, and young adults. Articles published up to 2020 were searched and those with information on BMI, chronotype and social jet lag, obtained through questionnaires, were included. Information on gender, age, country of publication, as well as the tool to assess sleep patterns was also included.

Results: A total of 21 articles were identified, with data relating BMI to chronotype and/or social jet lag in adolescents. Of the 16 articles that analyze the relationship between chronotype and BMI, 10 found a positive and statistically significant relationship between an evening chronotype and an increase in BMI. Of the 13 articles that analyze the relationship between social jet lag and BMI, in 7 a positive and statistically significant association was found between those adolescents with greater jet lag and those with a higher BMI.

Conclusions: Published studies show that in addition to sleep deprivation, variables such as chronotype and social jet lag must be considered when studying the factors that contribute to obesity in this population. Healthy sleeping patterns need to be incorporate as a key component in the promotion of healthy habits to prevent obesity in this population.

Keyword: sleep patterns, obesity, review, social jet lag, chronotype

Conflict of Interest Disclosure: none

PAB(T1)-32

Analysis of genetic polymorphism of bitter taste receptor TAS2R19 and its relationship with alcohol drinking and eating habits in Japanese subjects.

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Background and objectives: Five basic tastes are messages that tell us something about what we put into our mouth, so we can decide whether it should be ingested. Among them, the bitter taste sense is thought to have arisen to warn individuals against the ingestion of poisonous substances, many of which have a bitter taste. However, bitter substances are contained in favorite beverages such as tea and beer, etc., and have been widely consumed in usual human life. Bitter substances are perceived by various bitter taste receptors (TAS2Rs), and among them it is well understood that the TAS2R38 gene polymorphisms influence individual differences in bitterness sensitivity to phenylthiocarbamide or propylthiouracil. Some TAS2R has also been reported to be associated with disease defence system. On the other hand, As for the other bitter components in foods, such as naringin in grapefruit, previous studies suggest that TAS2R19 is associated with the relationship between grapefruit preference and genetic polymorphism of TAS2R19 in Western subjects, however, there have been very few reports regarding Japanese subjects, so the present study takes advantage of the Tohoku Medical Megabank Organization (ToMMo) database to investigate the relationship of those in the Japanese population.

Methods: The samples used here were from the TMM CommCohort Study participants, all of whom gave their written consent. The same ToMMo individual genotype construct genome reference panel for the Japanese population (2KJPN=~2000 subjects) was used. So, we extracted the aggregated data from dietary habit by questionnaire, and also analyzed single nucleotide polymorphism (SNP) in TAS2R19. Then we further analyzed if any specific TAS2R19 polymorphism (the 299th amino acid is either cysteine (C) or arginine (R) and other biological data are associated with clinical BMI, smoking habit, alcohol drinking frequency, food preference related to bitterness.

Results: After our detailed analyses, it was shown that the gene frequencies of C299C, R299C, and R299R were approximately 5%, 35%, and 59%, respectively in Japanese ToMMo population. Moreover, there was no significant relationship between the genetic polymorphism of TAS2R19 and clinical BMI, smoking habit, alcohol drinking frequency.

Conclusions: TAS2R19 was not associated with lifestyle-related factors in the Japanese population.

Further Collaborators Kunio Isono, Shizuko Satoh-Kuriwada

Keyword: Bitter taste receptor, Questionnaire analysis, Bitter taste foods.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: none

PAB(T1)-33

Effects of genetic variation on diet-induced thermogenesis in healthy young women

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Background and objectives: In modern Japanese society, the diversification of lifestyles has led to meals becoming markedly more Westernized, and there are concerns that these changes may lead to future health issues. Diet-induced thermogenesis (DIT) plays an important role in energy metabolism. Enhancement of DIT is expected to prevent fat accumulation and therefore obesity by increasing energy expenditure in response to overeating. This research aimed to determine whether single nucleotide polymorphisms (SNPs) of thermogenesis-related genes affect DIT after consuming a high-fat meal.

Methods: Participants were 35 healthy young women. We measured oxygen consumption, metabolic rate, respiratory quotient, and heart rate for 360 min before and after a standard (control) meal and a high-fat meal. The standard meal was 650 kcal, with a protein:fat:carbohydrate (PFC) ratio of 16:26:58. the high-fat meal was also 650 kcal, with a PFC ratio of 17:53:30. We asked participants about their lifestyle, measured their body composition, collected oral mucosa, and analyzed 3 SNPs of thermogenesis-related genes, namely, β2 adrenergic receptor (β2-AR), β3 adrenergic receptor (β3-AR), and Uncoupling protein 1 (UCP1). The study was approved by the Kyoto Women's University Research Ethics Committee.

Results: The β2-AR genotype was classified as 34% GG homo, 34% AG hetero, and 31% AA wild type; the β3-AR genotype was classified as 0% CC homo, 34% TC hetero, and 66% TT wild type; and the UCP1 genotype was classified as 20% GG homo, 57% AG hetero, and 23% AA wild type. The genotype of β2-AR and β3-AR did not affect DIT, but the homo mutant type of UCP1 tended to have a significantly lower DIT compared with the hetero mutant and wild type of UCP1 in both the standard and high-fat meals.

Conclusions: The results suggest that DIT might be affected by SNPs of UCP1 regardless of diet composition in healthy young women.

Keyword: Diet-induced thermogenesis, β3-AR, β2-AR, UCP1

Conflict of Interest Disclosure: none

PAB(T1)-34

Food Preferences among Women of Reproductive Age in Mainland Tanzania: A Qualitative Study

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Background and Objectives: In Tanzania, about 45 percent of women aged 15 to 49 years and 57 percent of pregnant women are anemic, and one in three women suffer from multiple micronutrient deficiencies. These nutrition-associated problems are among the main causes of maternal mortality and generally poor birth outcomes. This trend makes Tanzania lag behind in meeting the Sustainable Development Goal 3 target of <;70 deaths per 100,000 live births by 2030. There is a need to better understand women's food preferences to design interventions to promote nutritious, acceptable dietary practices. The primary objective of the survey is to identify food preferences for women of reproductive age, adolescent girls, and children in Tanzania.

Methodology: This will be a cross-sectional descriptive qualitative study that is being conducted in urban and rural districts in each of the main zones of mainland Tanzania. Primary data is collected through semi-structured interviews and focus group discussions to get insight into food preferences and influential community and macro level factors, and highlight available opportunities and gaps for maternal nutrition. The study primarily targets women of reproductive age (15-49 years)—specifically pregnant women, mothers/caregivers of children aged 6-24 months, adolescent girls, and key influencers, such as health workers and community leaders. Recruitment of study participants took into account rural and urban consideration to gauge variations in perspectives on food preferences. A minimum of three focus group discussions and six semi-structured interviews will be conducted in each region, making a minimum of 21 focus groups and 42 interviews. Data categorization and analysis will be done with the aid of NVivo.

Results: The study is planned to be completed by August 2022. They will provide information on food preferences, factors influencing dietary choices, barriers and facilitators for food choices, as well as existing interventions on nutrition behaviours in the community.

Conclusions: The study findings will inform interventions to promote maternal nutrition counselling on appropriate dietary intake in the communities that are being studied.

Keywords: dietary practices, food preferences, women, children, adolescents

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-35

A pilot study exploring the association of zinc-related genetic variants with risks for metabolic outcomes among adult Filipinos

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Background and objectives: Several studies have shown that an imbalance in zinc homeostasis causes increased susceptibility to chronic noncommunicable diseases (NCDs), such as hypertension, diabetes, and coronary heart diseases. These NCDs are the most prevalent diseases among Filipinos, where nutrition is a key factor, but the influence of an individual's genetic makeup must also be considered. Single nucleotide polymorphisms (SNPs) as a genetic risk factor may affect an individual's susceptibility to Zn deficiency, blood zinc status, and increased risks of developing chronic diseases later in life. We investigated in this pilot study the effect of zinc-related SNPs on the risks for various metabolic outcomes among Filipinos.

Methods: Using the 8th Philippine National Nutrition Survey data, we determined the SNPs associated with serum zinc concentration and zinc deficiency risk among ~1,200 adult respondents residing. We then performed multivariate linear and logistic regression analyses to investigate the association of zinc-related SNPs with various health indicators and the risks for diabetes, dyslipidemia, hypertension, obesity, and central obesity following an additive genetic model of inheritance. Models were adjusted for covariates, and a p-value <;0.05 was considered statistically significant.

Results: We initially identified 14 SNPs that statistically demonstrated variations in zinc levels across genotypes, 16 SNPs associated with serum zinc concentration, and 22 SNPs associated with zinc deficiency among study participants. ADIPOQ/ADIPOQ-AS1 rs2241766, IL12B rs3212227, OTOGL rs7315692 and rs7295948, PRKCA rs228883, and SLCO1B1 rs2291075 had shown effects on the genetic determination of both serum zinc and zinc deficiency risk. There are 15 zinc-related SNPs found to influence health indicators and their association with chronic metabolic outcomes. We observed repeated associations as follows: LINC02669/LOC105376360 rs2165468 with diabetes, dyslipidemia, and hypertension; FKBP5 rs1360780 with diabetes, hypercholesterolemia, obesity, and central adiposity; FKBP5 rs9470080 with abnormal lipid profile; PPIG rs13382615 with diabetes and hypertension; PCSK1 rs6234 with hypoalphalipoproteinemia and hypertension; KNG1 rs10937266 with diabetes and obesity; KNG1 rs11927941 with hypertriglyceridemia and obesity; and TMPRSS6 rs1421312 with hypercholesterolemia, obesity, and central adiposity.

Conclusions: This is the first report on genes and SNPs associated with increased risk of zinc deficiency and its influence on chronic metabolic outcomes among Filipinos.

Keywords: Philippine NCDs, Genetic epidemiology, Metabolic outcomes, Single nucleotide polymorphisms, Zinc

Conflicts of interests: none

PAB(T1)-36

F1kdayswithu app: development and pilot testing of an android mobile application on the first 1000 days of life to improve maternal and infant nutrition

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Background and objectives: Maternal and infant malnutrition in the Philippines is still prevalent; however, evidence showed that one effective way to prevent this is through nutrition education. Although mobile phone users have been increasing in the country, there is still no single mobile application that provides nutrition education on maternal, infant, and young children. Therefore, this study aimed to develop a mobile nutrition application that will provide nutrition education and monitoring on the First 1000 days of life.

Methods: The study utilized a design-based research method with a mixed-method approach. A pre-Knowledge, Attitudes, and Practices (KAP) survey was conducted for targeted participants about nutrition in the first 1000 days before the application's pilot testing. The researchers also conducted a post-KAP survey to check the effectiveness of nutrition education using the application and a User Acceptance Test survey for its user acceptance to determine the need for enhancement based on participants' evaluation. Participants were from Malabon City, excluding the application developer.

Results: The developed mobile application has features such as user login, language options of Filipino or English, nutrition education modules on pregnancy, lactation, infancy, young child, push notifications, ToDo task, and monitoring features such as pregnancy weight gain tracker and child's developmental milestones checklist. A total of 21 participants took part in the application pilot testing, and the majority of them (>;50%) had a high user acceptance level of the application. After using the application containing nutrition education, the pregnant women showed a significant improvement in their total nutrition knowledge scores (p=0.002). Mothers with below two-year-old children also showed a significant improvement in their total nutrition knowledge (p=0.026) and total correct nutrition practice scores (p=0.023).

Conclusions: The developed mobile nutrition application is engaging, efficient, easy to learn, and offers effective functionalities of features that cater to the needs of the target users in the first 1000 days of life. Providing nutrition education using a mobile application can help increase the knowledge of pregnant women and mothers. However, a longer duration of app usage may be more effective in changing their attitudes and practices.

Keywords: Application Development, Features, First 1000 Days, Nutrition Education

Conflicts of interests: none

PAB(T1)-37

Accuracy of estimates of serving size using digitally displayed food photographs among Japanese adults

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Background and objectives: We developed a digital photographic food atlas as a portion size estimation aid, using dietary records obtained from 644 Japanese adults. This study aimed to evaluate how accurately people estimate the amount of food they serve using images in the food atlas.

Methods: From 209 food items in the food atlas, we selected 14 with various appearances and textures for this study. At a study site, 54 participants (27 males and 27 females) aged 18–33 years were asked to serve each of the 14 foods in the amount they usually eat. After they left, a researcher weighed each food. The next day, the participants answered a web questionnaire asking about the amount of food they served on the previous day based on the photographs of portions for each food item. The weights of foods the participants served (true serving sizes) and those determined using the photographs (estimated serving size) were compared. Moreover, the associations between estimation error and participant characteristics (age, sex, body mass index, occupation, cooking frequency, and hunger level) were evaluated.

Results: In 10 of the 14 foods, there was a significant difference between the estimated and the true serving sizes, ranging from 29.8% underestimation (for curry sauce) to 34.0% overestimation (for margarine). On average, the relative difference was 8.8%. Overall, 51.6% of the estimates were within ±25% of the true serving size, ranging from 18.5% (for Japanese fried chicken) to 81.5% (for simmered squash). Bland–Altman plots showed wide limits of agreement and increased variances with larger serving sizes for most foods. Overall, no association was found between estimation errors and participant characteristics.

Conclusions: The ability to accurately estimate the serving size of foods using digital food photographs was limited, both at the group and the individual levels. This finding indicates that further development, refinement, and testing are needed to improve the accuracy of portion size estimation using the digital food photographic atlas.

Keywords: Dietary assessment, serving size, validation study, food photograph, Japan

Conflicts of interests: none

PAB(T1)-38

Association between robustness of 24-hour pattern of sleep/wake, energy intake, and interstitial glucose level over seven days among young adults

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Background and objectives: Glycaemic variability (GV) is associated with obesity and cardiovascular diseases. Sleep and dietary intake are behavioural factors which impact glucose metabolism. However, no study explains whether robustness of the 24-hour patterns in sleep/wake and energy intake are independently associated with GV. Therefore, our study aimed to explain the associations in young healthy adults.

Methods: Eighty-seven healthy university students participated in this cross-sectional study. They recorded the time of each meal and amount of food and beverage consumed during seven days of actigraphy and flash glucose monitoring under a free-living situation. Additionally, they completed a self-administered questionnaire about demographics, morning-eveningness, and dietary intake over the previous month. The actigraph was continuously worn to record wrist activities every minute with a zero-crossing method. Cole-Kripke algorithm was applied to the recorded data to score sleep or wake (1/0) in each one-minute epoch. Interstitial glucose data were processed using band-pass filtering from 2- to 12-hour for ultradian component and 21.8- to 26.7-hour for circadian component. For the sleep/wake, energy intake, and original and filtered glucose data, the interdaily stability (IS) was calculated. IS measures the similarity in the daily 24-hour pattern. Multivariable linear regressions were performed with IS of glucose level as the dependent variable and IS of the sleep-wake pattern, IS of energy intake, and confounding variables (sex, body mass index, residential status, and experience of working at night) as independent variables.

Results: For the original glucose data and its circadian component, IS of energy intake was significantly and positively associated with IS of glucose level, but IS of the sleep-wake pattern was not. For the ultradian component, lower IS of both the sleep-wake pattern ($\beta = 0.30$, 95%CI = 0.13 – 0.48) and the energy intake ($\beta = 0.78$, 95%CI = 0.50 – 1.05) were significantly associated with a lower IS of glucose level. These results did not change when the morning-eveningness score and/or percentage of energy intake at snack was added to the models.

Conclusions: Robustness in 24-hour pattern of sleep-wake cycle and energy intake may be independently associated with a robustness of ultradian glycaemic rhythm.

Keywords: Chrononutrition, Sleep-wake cycle, Interdaily stability, Flash glucose monitoring, Dietary intake

Conflicts of interests: none

PAB(T1)-39

Implementation of process-guided dietetic practice: Comparison of validated methods to collect data for the Diet History

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Background and objectives: Strengthening process-guided and evidence-based dietetic practice is important for improving the quality of dietetic care. The Diet History is a key category for collecting client-related data in the Dietetic Assessment at the beginning of process-guided dietetic practice in the Dietetic Care Process (DCP) and there is a need to propose validated methods. The aim of the present research was to give an overview of the evidence-based methods for the Diet History and to derive recommendations for its use in process-guided dietetic practice.

Methods: The systematically performed literature research and the additional hand search were conducted between October and December 2020 in three databases. They focused on validated survey methods based on respondents' self-reporting. Results were limited to publications from the past 20 years in English and German language. Studies were analysed using the STARD-Standard and Best Practice-Criteria for Self-Report Dietary Assessment Methods by Kirkpatrick et al. 2019.

Results: 31 publications on 24-hour recalls, food records, and photo-based methods were included. Only four studies focused on dietetic practice, the others mainly on nutritional epidemiology. None of the studies explicitly addressed process-guided Dietetic Assessment. There was a clear trend towards electronic dietary assessment instruments, which were used by the participants themselves and were (partly) automatically analysed.

Conclusions: Studies relating validated methods for the Diet History in process-guided Dietetic Assessment are limited. Recommendations for the use of assessment methods especially for the Diet History must be evidence based. Choosing a suitable method for the Diet History should consider individual characteristics of respondents as well as the design and implementation of the dietary assessment methods. Respondent characteristics should focus on demographic and socioeconomic factors, body mass index, literacy and language. Regarding the design of the methods, the instruments should not only include nutrients but also foods. Training sessions and/or help functions should be provided to facilitate the implementation of the methods by participants. There is a clear focus on innovative digital methods with verbal and visual assistance features. For strengthening the evidence-based dietetic practice it is necessary to improve the available evidence for the Diet History.

Keywords: Evidence-Based Dietetic Practice, Process-guided Actions, Dietetic Care Process, Dietetic Assessment, Diet History

Conflicts of interests: none

PAB(T1)-40

Development of behaviour change support for young adults within a randomised controlled trial

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Background and objectives: Multiple frameworks based on behavioural models exist to guide researchers on the development of health interventions. Utilising the frameworks has the potential to enhance participant adherence, improve research validity and decrease resource waste, although research on the implementation and efficacy of such is limited. Therefore, the objective of this study is to describe the development of a user-centred, theory-based, eHealth behaviour change support (BCS) programme to support young adults' (20-35 years) to adhere to the behaviours of (i) following the prescribed 'healthy' diet, and (ii) record dietary intake on a smartphone app, when participating in a nutrition trial.

Methods: The Nine Principles framework was used to develop the BCS, which involved a literature review, qualitative research through focus groups with experts and end-users, integration of the Theory of Planned Behaviour, and a 10-week pilot trial with 20 participants. Mixed methods outcomes range from focus group inductive thematic analysis, process evaluation, and behaviour adherence and social media engagement during the pilot.

Results: The Nine Principles framework enabled the development of a feasible BCS programme within a nutrition trial. The BCS appeared to support optimal dietary recording, which can be a burdensome behaviour for participants, and helped participants maintain current dietary behaviours. Piloting highlighted the importance of identifying acceptable modes of delivery.

Conclusions: Using a framework underpinned by theory and user-centred design to develop BCS is a promising avenue to enhance adherence in nutrition research trials. Further practical support is needed to guide researchers through this development process.

Keywords: Behavior Therapy, Food Habits, Nutrition, Trial Design

Conflicts of interests: none

PAB(T1)-41

Description and performance evaluation of two new web-based tools developed to assess and monitor diet quality: Nova-HF and Nova-UPF screeners

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Background and objectives: The quality of diets and risk of chronic diseases can be difficult to evaluate or monitor in some contexts due to the unavailability of tools that are simple and easy to collect. We developed two web-based tools to assess and monitor diet quality and described their performance against a traditional method of food consumption data collection.

Methods: This analysis included part of the participants of the NutriNet-Brasil study, a web-based prospective cohort that currently counts on more than 100,000 volunteers. A total of 812 adults (18 years or older) answered a 2-minute self-administered questionnaire about the consumption of a set of foods on the day prior to the interview. Food items were based on the Nova food classification system: the Nova screener of healthy foods (Nova-HF) is comprised of 33 whole nutrient-dense foods (fruits, vegetables, legumes, whole grains, and nuts), and the Nova screener of ultra-processed foods (Nova-UPF) includes the most consumed UPF in Brazil (23 food items). Each tool generates a score, which is obtained by the sum of positive answers. We compared the Nova-HF and the Nova-UPF scores to the total energy intake (%) from whole nutrient-dense foods and ultra-processed foods, respectively, obtained through a web-based open-ended 24-hours recall developed and validated specifically for the NutriNet-Brasil study, which considers the food processing degree. We evaluated the relationship between quintiles of each score and the correspondent % of energy intake by linear regression, and the agreement between the quintiles of each method, using the Prevalence-adjusted and bias-adjusted kappa (Pabak).

Results: Quintiles of each score presented a linear relationship with the correspondent % of energy intake (p-value for linear trend <;0.001). Quintiles of both scores presented a substantial agreement with the quintiles of correspondent % of energy intake (Pabak 0.72, 95% CI 0.68-0.76 for the Nova-HF score; Pabak 0.79, 95% CI 0.74-0.83, for the Nova-UPF score).

Conclusions: These two new screeners, applied in a quick and practical manner, presented a good potential in reflecting the dietary share of whole nutrient-dense foods and ultra-processed foods in Brazil, and represent an easy tool to evaluate and monitor diet quality. [Conflict of Interest Disclosure] No conflicts of interest.

Keywords: Food Consumption, Diet Surveys, methods, Surveys and Questionnaires, Validation Study, Diet Quality

Conflicts of interests: none

PAB(T1)-42

The evaluation of the characteristics in Washoku by using the food–model SAT nutrition-education system.

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Background and objectives: Washoku, a traditional Japanese food is attracting attention both domestically and internationally as a healthy diet. Although there have been many reports examining the effects of individual components of foods used in Japanese meals on the body, there are few examples of examining an entire meal. In this study, we used a food model to examine the nutritional characteristics of Washoku as a whole meal.

Methods: A meal choice experiment was conducted on 166 subjects from 16:00 to 18:30 using a food model system (Iwasaki Co., Ltd.). The food model was divided into two groups, Japanese food and non-Japanese food, using the definition of The Washoku Association of Japan (Ministry of Agriculture, Forestry and Fisheries). There was no limit to the amount or number of meals, and we asked them to freely choose from Japanese food and non-Japanese food once each in a buffet style. Total energy and various nutrient levels were measured by the Food-Model SAT nutrition-education system.

Results: Total energy and total lipid were significantly lower in the Japanese diet than in the non-Japanese diet, demonstrating the characteristics of the Japanese diet that total energy and total lipid can be kept low even when dietary choices are made with no restrictions on diet content or quantity.

Keywords: Japanese diet, food model system, nutrition, washoku

Conflicts of interests: none

PAB(T1)-43

Quality comparison of nutrition information on Twitter with and without a secondary share

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Introduction: The internet is a common source of health information for the public but is largely unregulated with anyone able to create and share content1. Social media channels, including Twitter, facilitate easy and rapid dissemination of content, including nutrition and health information2. Therefore, it is increasingly important to be able to differentiate between

higher- and lower-quality nutrition information. Using a novel online quality assessment tool (OQAT)3, this work aimed to assess the quality of online nutrition information disseminated via Twitter from different sources of information and examine those that had >;1 secondary share (retweet) in comparison to unshared content.

Methods: The Twitter API, Tweet Archiver, was used to collect tweets posted on six randomly selected dates in 2021 that included the term 'nutrition'. Tweets were initially screened to identify those containing Uniform Resource Locators (URLs) and sorted based on secondary shares. Each URL was reviewed manually and categorised based on the website source and the content type before being assessed against the 10 OQAT criteria. A higher OQAT score indicated a higher quality article.

Results: Over the collection period, 11,204 URLs were collected from 16,262 Twitter posts (1,646 shared, 9,558 not shared). After manual screening for relevance to human nutrition and health, these represented: 68 news articles (34 shared, 34 no share) and 628 blogs (240 shared, 388 no shares). 10,508 URLs were excluded as out of scope (e.g. advertising, scientific papers, social media accounts). T-test showed a significant difference in OQAT score between blogs (n=628, mean=6.24) and news articles (n=68, mean=7.26), difference= -1.02 (95% CI -1.396 to -0.649), p<;0.001.URLs that did not have a secondary share (n=422, mean=6.47) scored higher on the OQAT than those that had been retweeted (n=274, mean=6.14), difference=0.32 (95% CI 0.065 to 0.606), p=0.008.

Discussion: This investigation of the quality of online nutrition information shared on Twitter, found blogs were the most widely shared content type but were the lowest quality. Articles retweeted were of lower quality than those unshared, as assessed by the OQAT. These data suggest that caution is required when using, and sharing, blogs as a source of nutritional information.

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Keywords: social media, Nutrition information, Online nutrition information, Twitter, Quality assessment

Conflicts of interests: none

PAB(T1)-44

Impact of vitamin B12 supplementation on streptozotocin-induced diabetic rat brain.

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Background & Objectives: Diabetes mellitus is associated with increased risk for neurodegenerative disorders. Vitamin B12 is an essential micronutrient, whose deficiency has also been linked to neurodegenerative conditions including cognitive impairment. Accumulation of misfolded proteins altered neurotrophic support, astrogliosis, synaptic dysfunction, and defects in autophagy are associated with neurodegenerative diseases. Hence, in this study, we investigated the neuroprotective role of vitamin B12 and its molecular basis in diabetic rat brain.

Methods: Diabetes was induced in two-month-old Sprague-Dawley rats using streptozotocin and animals were divided into 3 groups: control (CN), diabetes (D), and diabetes with B12 supplementation (DBS). DBS group was fed double the amounts of B12 (50 µg/kg diet) in comparison to the CN and D groups. At the end of four months, the cerebral cortex (CC) tissue was collected. The histopathology was performed using H&E staining and nissil body staining, and cell death by TUNEL assay. Furthermore, markers of neurotrophic support, synaptic density, ER stress, the ubiquitin-proteasome system (UPS), and autophagy were analyzed by immunoblotting and immunofluorescence methods.

Results: Vitamin B12 supplementation to diabetic rats showed a reduction in cellular degeneracy with fewer halos around the cells, increased neuronal cell density, and decreased chromatolysis. Additionally, B12 supplementation restored the neurotrophic factors, improved the synaptic density-related markers, and attenuated the astrogliosis. Furthermore, B12 supplementation reduced the ER stress and alpha-synuclein expression. In tune with these changes, B12 supplementation decreased neuronal cell death.

Conclusion: This study demonstrates a neuroprotective role of B12 in ameliorating diabetes-induced neurodegeneration by modulating ER stress, astrogliosis, neurotrophic support, and abating cell death. This study is likely to help in developing B12 mediated therapeutic strategies for diabetes.

Keywords: Diabetes Mellitus, Neurodegeneration, Vitamin B12, Neurotrophic Support, Synaptic density

Conflicts of interests: none

PAB(T1)-45

Effect of a mobile app on breastfeeding rates among mothers who have cesarean delivery: A randomized controlled trial

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Background and objectives: Cesarean section has negative impacts on breastfeeding rates. This study is to evaluate the effect of a mobile application on breastfeeding outcomes among mothers who had cesarean section using a randomized control trial in Vietnam in 2020 - 2022.

Methods: A triple–blinded randomized trial of a mobile application was conducted. The mobile application was tailored to Vietnamese culture with two separate versions for the intervention and the control group. The intervention version auto-generated three messages per week and linked the

information in the library content to improve breastfeeding while the control version sent messages on maternal and child health care. Pregnant mothers were recruited during their antenatal visits and randomly assigned to two groups. Outcomes of interest included early initiation of breastfeeding and exclusive breastfeeding rates.

Results: A total of 275 mothers in the control and 293 in the intervention group who had undergone a cesarean section were included in the analyses. Significant increases were observed for early initiated breastfeeding within two hours (aOR= 1.51, 95%CI: 1.01 to 2.27) and exclusive breastfeeding during hospital stay (aOR=1.59, 95%CI: 1.02 to 2.49).

Conclusion: Our results support the use of a theory-based design mobile phone application as a part of a promising intervention to improve breastfeeding outcomes.

Keywords: breastfeeding, mobile application, cesarean section, early initiation, mHealth

Conflicts of interests: none

Funding: This research was funded by a grant from the Vietnam National Foundation for Science and Technology Development (NAFOSTED) and the National Health and Medical Research Council of Australia under grant number NHMRC.108.03-2018.09. The funders had no role in the design and conduct of the study.

PAB(T1)-46

Stereo-Camera based vessel dimension and food portion size estimation in Ghana

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Background and objective: The African continent, particularly the sub-Saharan region including Ghana, is burdened by undernutrition and obesity. Understanding food intake is critical to developing solutions. However, traditional food intake monitoring tools are known to be inaccurate and sensor-based methods are being explored to enhance accuracy. This study explores the use of a stereo-camera to determine eating vessel dimensions and estimate portion sizes of foods and beverages such as soups, stews, rice, and teas from captured images. The study was funded by the Bill and Melinda Gates Foundation.

Methods: Households from rural and urban Ghana in and around Accra participated in this study and their food intake was monitored by the FOODCAM for 3 days. The FOODCAM is a passive, standalone stereo-camera that can be mounted above an eating location. Using stereo-vision, the vessel dimensions were extracted. Essentially, the pixels from one stereo- image were matched with pixels of the second and stereo-camera parameters were used to estimate the same point in 3-dimensional (3-D) space. Vessels were classified as flat plates or cylindrical/ hemispherical/ frustum vessels. The start and end images of eating occasions were used to determine portion consumed. Based on the vessel shape and dimensions the volumes of the consumed food were estimated. Using FAO/INFOODS food database density tables (2012), weights of the portions were estimated and compared with ground truth weights calculated estimated from researcher-conducted weighed food records.

Results: Using the FOODCAM, we estimated vessel dimensions in the laboratory with mean±SD error percentages of -5.83±2.59 in radius/side estimation and -9.27±3.95 in vessel depth, respectively. Preliminary results using FOODCAM images from the field study (15 foods and beverages from 4 households) showed estimated food portion size resulted in an error percentage of -11.27 ± 15.49.

Conclusion: These results show the potential of the FOODCAM and the associated stereo-vision methodology as an accurate, semi-automatic way to estimate the dimensions of eating containers from an overhead food camera and determining food portion size in free-living conditions.

Keywords: technology-based dietary assessment, sensors, Ghana, food portion size estimation, Africa

Conflicts of interests: none

PAB(T1)-47

SAHH inhibition induces endothelial senescecne and accerlerates atherosclerosis via epigenetic regulation of Drp1-mediated mitochondrial fission

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Background and objectives: Endothelial senescence plays a critical role in the development of atherosclerosis. Elevated S-adenosylhomocysteine (SAH) level results from inhibition of S-adenosylhomocysteine hydrolase (SAHH) is one of the risk factors of atherosclerosis. However, the relationship between endothelial senescence and SAHH inhibition is largely unknown and is the goal of the current study.

Methods: Serial passage human umbilical vein endothelial cells (HUVECs) were used to explore the association between SAHH expression and replicative senescence. HUVECs treated with SAHH-specific inhibitor adenosine dialdehyde (ADA) and SAHH-siRNA, SAHH+/-mice and ApoE-/- SAHH+/-mice were used to assess the effect of SAHH inhibition on endothelial senescence in vitro and in vivo. RNA-sequencing, Whole Genome Bisulfite Sequencing (WGBS) and adenoviral-transfection were conducted in HUVECs for mechanism investigations. In addition, a 1:1 matched case-control study of vascular aging (n=188 for each group) was conducted to verify the conclusion epidemiologically.

Results: As HUVECs were passaged, distinct senescence morphology was observed together with decreased SAHH expression and increased intracellular SAH levels. SAHH inhibition treatment with ADA or SAHH siRNA elevated SA-β-gal

activity, arrested proliferation, and elevated the expression levels of p16, p21 and p53 in HUVECs and the aortas of mice. GO enrichment analysis of both RNA-sequencing and WGBS data revealed that genes related to mitochondria fission were differentially expressed after SAHH inhibition treatment. A fission morphology of mitochondria and downregulation of Drp1 were also observed in subsequent assays. Notably, further knock down of Drp1 using siRNA maintained the mitochondrial morphology and rescued the senescence phenotypes in endothelial cells undergoing SAHH inhibition. After fed on AIN-93G diets for 10 weeks, ApoE-/- SAHH+/-mice showed increased lesion area compared with ApoE-/- littermates. However, Drp1 inhibitor mdivi-1treatment abrogated the effect above. Mechanistically, hypomethylation over the promoter region of Drp1 and downregulation of DNMT1 were found in HUVECs treated with SAHH inhibition. And DNMT1 overexpression using adeno-virus did upregulate the Drp1 expression. The case-control study suggested that plasma SAH levels was the risk factor of vascular aging, with adjusted OR= 3.425 (1.783-6.579) (Q4 vs Q1).

Conclusions: SAHH inhibition induces endothelial senescence and accelerates atherosclerosis via epigenetic regulation of Drp1-mediated mitochondrial fission.

Keywords: S-adnosylhomocysteine, endothelium, cellular senescence, methylation, atherosclerosis

Conflicts of interests: none

PAB(T1)-48

Skeletal muscle mass and expressions of the myostatin and follistatin in vitamin D receptor gene knockout mice, and its gender difference

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Background and objectives: It has been known that vitamin D deficiency is linked to muscle weakness and falls. Vitamin D receptor (VDR) is present in normal muscle even at very lower levels than the main target tissues like the intestine, kidney, and bone. To confirm the role of VDR in muscle, muscle mass and the gene expression of myogenic related factors in male and female VDR gene knockout mice (VDRKO) were investigated.

Methods: Littermates of wild-type and VDRKO mice were fed a normal (Ca 1.2%) or high calcium diet (Ca 2.0%, lactose 20%). Muscle mass in the lower leg was measured using the Micro-CT scanners for small experimental animals (Latheta LCT-200, Hitachi, Ltd., Japan). Gene expression of myostatin and follistatin in quadriceps were analyzed using qRT-PCR.

Results: In the feeding of a normal diet, the body weight and muscle mass of VDRKO mice were significantly lower, and expression of myostatin mRNA was higher than those of wild-type mice in both males and females. In the feeding of a calcium rescue diet, hypocalcemia of male and female VDRKO mice were improved, and the muscle mass of female VDRKO mice improved to an equal level of wild-type mice. However, the improvement of the muscle mass of male VDRKO mice was not improved completely. No difference was observed in the expression of follistatin mRNA between wild-type mice and VDRKO in both kinds of diets.

Conclusions: The results suggest that one of the mechanisms for the effect of vitamin D on muscle mass is increased myostatin gene expression mediated by hypocalcemia. Moreover, incomplete improvement of muscle mass was observed in male VDRKO mice despite improved hypocalcemia and myostatin gene expression, which suggests that the effects of vitamin D on muscle mass are more likely to occur in males via androgens or unknown factors.

Keywords: vitamin D, muscle, vitamin D receptor, myostatin, Vitamin D receptor gene knockout mice

Conflicts of interests: none

PAB(T1)-49

Data science meets nutrition: A systematic scoping review on the use of computational sentiment analysis to explore the language of nutrition, food and cooking related social media posts

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Background and objectives: Generally, research on nutrition, food and cooking related information on social media has been limited to manual content analysis and small sample sizes. Sentiment analysis is a data science technique which can analyse the emotion (e.g. positive, negative or neutral) from large datasets, however it is currently unclear of its applicability in the context of nutrition. The aims of this review were to classify the areas of nutrition that have been explored using sentiment analysis, the sentiment analysis techniques used and their potential efficacy.

Methods: Nine databases from both health and data science were searched for journal articles or conference papers that conducted computational sentiment analysis on nutrition, food or cooking social media content.

Results: Searches returned 7325 papers of which 38 papers from 37 studies were eligible. The range of nutrition related topics varied including areas such as dietary patterns and choices, cooking, health status and public health nutrition programs. Not all studies reported the accuracy of the sentiment tool to predict sentiment. Of those that did, accuracy ranged from 33.3% to 98.5%, with neural network engines which were purpose built for the topic having the highest accuracy - up to 98%. Typically, open-source tools were not assessed for accuracy or had accuracy as low as 33.3%. The proportion of sentiments

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

varied, with the proportion of positive posts ranging from 12.9% to 79.2% (average 40.1%), neutral from 5% to 76.9% (average 46.3%) and negative from 6.1% to 82% (average 25.8%). Alongside sentiment analysis, other analyses were often conducted to explore the social media data further. These included topic modelling which uses algorithms to create themes based on frequent words; social network analysis which explores the network of social media users; and classification systems to assess the healthiness of the foods mentioned.

Conclusions: Open-source sentiment analysis methods should be used with caution in the nutrition context as accuracy may be low. Multi-disciplinary work (including data science and nutrition subject experts) and use of techniques beyond sentiment analysis are key to the successful implementation of data science methods that are rigorous, relevant to the specific field and practical.

Keywords: Nutrition, Social media, Sentiment analysis, Data science

Conflicts of interests: none

PAB(T1)-50

Development of a method to assess provitamin A bioequivalence from mixed diets by applying model-based compartmental analysis to theoretical datasets for healthy young females.

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Introduction: In several studies, model-based compartmental analysis has been used to estimate the bioequivalence of β-carotene (provitamin A) to retinol after subjects ingest stable isotope-labelled β-carotene in oil. Objective: Our objective was to develop a method to determine the bioequivalence of dietary provitamin A in theoretical women that can later be applied in free-living subjects fed mixed diets.

Methods: We postulated retinol kinetic parameters for 6 theoretical women with low, moderate, or high assigned values for vitamin A (VA) total body stores (TBS) and VA intake. We assumed subjects ingested a single dose of [13C] retinyl acetate and that from d 14-28, daily VA supplements (0, 200, 400, 800, 1600, or 2000 µg retinol) were consumed, with the study repeated at each supplement level in each subject. Using a previously published 8-compartment model for whole-body VA metabolism which assumed homeostatic control of plasma retinol concentration, we simulated plasma retinol and plasma retinol specific activity (SAp) using the Simulation, Analysis and Modeling (WinSAAM) software. Then for each subject, we calculated the change in SAp on d 28 for each supplement and developed an equation to predict percentage drop in SAp (bioequivalence) as a function of VA in diet + supplement.

Results: Higher doses of VA supplement resulted in lower SAp such that there was a clear dose response between supplement load on d 14-28 and SAp. Bioequivalence data fit an equation describing saturation kinetics.

Conclusion: These results suggest that, by applying a similar protocol in free-living subjects (single oral dose of stable isotope-labelled VA, a controlled diet varying in provitamin A, and limited blood sampling), compartmental modelling can be used to predict β-carotene bioequivalence from a mixed diet.

Keywords: provitamin A, bioequivalence, model-based compartmental analysis, retinol isotope dilution method, theoretical humans

Conflicts of interests: none

PAB(T1)-51

Effect of ice slurry oral intake before bedtime on sleep

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Background and objectives: sleep disorders are a major social problem that prevails in modern society, and urgent action is desired. Currently, many supplements that were supposed to improve the sleeping environment on the commercial market. However, the effect is extremely weak compared to the prescription. Ice slurry ingestion before exercise is based on evidence that reducing one's initial core temperature allows for a greater heat storage capacity during exercise and in turn prolongs the onset of hyperthermia-induced fatigue. It was well-known that major previous sleep studies have observed a decrease in core body temperature from the time of falling asleep. The purpose of this study was to investigate effect of ice slurry intake before bedtime to lead to falling asleep quality in Japanese summer.

Methods: Eleven volunteers (age = 21 ± 3years, height = 1.59 ± 0.14 m,), three male and eight female were participated in this study. It was performed to sleep intake ice slurry (100g/pack, Otsuka Co.) or not as control condition in each own bedroom environment with wearing sensor for sleep assesment and indoor climate environment recording. This experiment was performed from July to August in hot and humid Japanese summer. The study protocol was approved by the Ethics Committee of Jissen Women's University (AC_2019 _11_S) in Japan. All participants provided written informed consent prior to commencing the study. The study complied with the latest version of the Declaration of Helsinki and was conducted according to international standards.

Results: There were recorded totally 196 nights, then acquisition successful 158 night's sleep and indoor climate data. It was a found at the time of sleep as Japanese summer, 30 degrees centigrade and 89% humidity in bedroom climate. There was a significant different in non rem sleep period longer

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

between ice slurry or not.

Conclusions: Consequently, there was a tendency that the deep sleep time was longer when ingested. Therefore, it was suggested that the decrease in core body temperature due to ice slurry improves the quality of sleep.

Keywords: ice slurry, sleep, indoor climate

Conflicts of interests: none

PAB(T1)-52

Daily iron intake through biofortified crops-based complementary foods and impact on iron indices

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Background and objectives: We conducted a randomized controlled trial (RCT) of complementary foods prepared using iron-biofortified pearl millet (FePM, Dhanashakti) compared to conventional PM (CPM) from 2017–2018 among n=223 children in urban slums of Mumbai (NCT02233764). While there was no overall effect of the intervention on markers or iron status, the RCT results were consistent with previous FePM studies, and improvements in hemoglobin concentrations were observed among male children and children who were iron deficient or depleted at baseline. In this abstract, we aimed to examine the association of daily iron intake with changes in hemoglobin.

Methods: FePM- or CPM-based foods were offered to children 6 days per week (excluding Sundays) for 9 months and weighed before and after eating to measure intakes. From weighed food records, daily pearl millet (g) and iron (mg) intake were calculated. We plotted dose-response curves examining the daily average iron intake to detect threshold effects as well as non-linear associations with hemoglobin and serum ferritin response using restricted cubic splines. Analyses were conducted on subgroups including those who were anemic (hemoglobin <;11.0 g/dL) or iron deficient (serum ferritin <;12.0 µg/L) at baseline.

Results: Children consumed a median (IQR) of 31.6 (28.3, 33.5) g FePM and 32.2 (29.1, 33.7) g CPM daily, resulting in intakes of 3.0 (2.7, 3.1) and 1.0 (0.9, 1.0) mg iron daily, respectively. Daily mean iron intake from FePM was associated with a linear improvement in hemoglobin concentration in children who were anemic at baseline, and iron deficient at baseline, in analyses using restricted cubic splines.

Conclusions: We observed that intake of FePM-based complementary foods for 9 months is associated with an improvement in hemoglobin concentrations among children 12–18 months of age, who are iron deficient or anemic.

Keywords: nutrition interventions, implementation, children, hemoglobin, iron

Conflicts of interests: SM is an unpaid board member for and has an equity stake in a diagnostic start up focused on developing point-of-care assays for nutritional status informed by his research as a faculty member at Cornell University.

PAB(T1)-53

Development of a quality assessment framework to support the reuse of existing datasets: a Food Nutrition Security Cloud (FNS-Cloud) project

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Background and objectives: Currently, existing data, tools and services in the area of nutrition, health and agri-food are fragmented, lack critical mass and access is unevenly distributed. The FNS-Cloud project aims to federate existing and emerging tools and datasets, in addition to developing new services into a single 'Cloud' to support their re-use. Whilst promoting the increasing reuse of data, it is imperative for the maintenance of scientific quality that all data selected for secondary analysis be fit for the intended research purpose. Thus, a quality assessment framework is needed in FNS-Cloud to support researchers in the decision-making process to assess whether data is appropriate for their research and ensure scientific quality is maintained. This work aims to describe the development of a quality assessment framework for FNS-Cloud.

Methods: Markers of quality were identified within the literature for dietary intake, lifestyle, demographic, anthropometric and consumer behaviour data domains where quality was considered at a data collection, data management and data analysis level. These markers were assessed and refined by expert researchers within the field of dietary intake, consumer behaviour and lifestyle data and then used to inform the development of a series of flow charts for each data domain.

Results: The flow charts comprise a series of questions relating to an aspect of quality specific to each data domain. Individualised messages specific to the answers given to each question were developed. The design requires researchers to answer a series of questions producing a personalized feedback report with additional considerations to support the researcher in their decision of whether the data they have selected is appropriate for their research question

Conclusion: Future work will focus on the implementation of this framework into the FNS Cloud solution by evaluating its use among a wider group of domain specific experts and translating the framework into an online tool. Work is ongoing in this project with the Cloud expected to be delivered by the end of 2023.

Funding: Food Nutrition Security Cloud (FNS-Cloud) has received funding from the European Union's Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3. – A sustainable and competitive agri-food industry) under Grant Agreement No. 863059 – www.fns-cloud.eu

Keywords: Quality assessment, dietary intake data

Conflicts of interests: none

PAB(T1)-54

Sociodemographic characteristics according to different food purchase patterns of Finnish households

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Background and objectives: Food retailers' loyalty-card data provide a unique tool for gaining insights into dietary patterns. The aim of this study was to identify differences of purchase patterns in different socio-demographic groups in Finland.

Methods: Loyalty-card holders of the largest grocery retailer in Finland (S Group) received an invitation to share their purchase data for research purposes. Those who gave their consent also filled out a questionnaire on, e.g., sociodemographic characteristics. Purchase patterns of 22,860 participants were identified using factor analysis for 56 aggregated food groups. Pattern scores between sociodemographic groups were compared (means).

Results: The six identified purchase patterns were Traditional, High-energy, Plant-based, Animal-based, Ready-to-eat, and Easy-cooking. Individuals ≧70 years (vs. ≦29 years) had higher scores in Traditional (0.61 vs. -0-62) but lower scores in High-energy (≧70 y: -0.92 vs. ≦ 29 y: 0.23). Those ≧ 70 years vs. ≦ 29 y had also lower scores in Easy-cooking (-0.59 vs. 0.46). Other patterns were not strongly associated with age. Those living in high-income households (≧4000 €/month) vs. low-income households (<;1000€/month) had higher scores in Animal-based (0.32 vs. -0.63) and Plant-based (0.18 vs. -0.21) but lower scores in Easy-cooking (-0.31 vs. 0.21). Those with higher-level tertiary education vs. those with primary school or less as the highest education had higher scores in Plant-based (0.36 vs. -0.40), Animal-based (0.14 vs. -0.31), and High-energy (-0.09 vs. -0.35) but lower scores in Traditional (-0.25 vs. 0.51), Easy-cooking (-0.25 vs. -0.01), and Ready-to-eat (-0.07 vs. 0.17). Families with children compared to households without children had higher scores in High-energy (0.58 vs. -0.33), Easy-cooking (0.33 vs. -0.18), and Animal-based patterns (0.17 vs. -0.11).

Conclusion: Plant-based, but also Animal-based purchase patterns, were more common in those with high education level and high household income. Replacement of animal-based with plant-based foods in these groups should be promoted to mitigate environmental impacts of food consumption. Families with children adhered strongly to the High-energy pattern characterized by high-energy low-nutrient foods, and Animal-based pattern. Therefore, in addition to targeting individuals with low income and low educational level with promotion of healthy food choices, families with children should be targeted. [Conflict of Interest Disclosure] Both the research group and the retailer signed a contract on data transfer, ensuring the independence of the research and scientific publishing from business interests. HV received a fee from the S Group. The collaboration included offering professional advice to influencers and writing a blog post about the interpretation of the nutrition calculator in S Group's mobile app.

Keywords: loyalty card, dietary pattern, socio-demographic factors, socio-economic

Conflicts of interests: none. MF is a member of the S Group's Advisory Board for Societal Responsibility. This membership involves no compensation.

PAB(T1)-55

Effects of dietary vitamin D deficiency on markers of skeletal muscle mitochondrial biogenesis, dynamics, and quality control

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Background and objectives: We examined the effects of dietary vitamin D deficiency on markers of mitochondrial biogenesis, dynamics, and quality control in rat soleus muscle.

Methods: Male Wistar rats were fed a chow with no vitamin D (No-D; 0 IU/kg) or a moderate dose of vitamin D (Mod-D; 2000 IU/kg) chow for 8 weeks.

Results: Compared to the Mod-D group, at 8 weeks the No-D group showed significantly lower serum 25(OH)d levels. Although vitamin D deficiency had no effect on body composition, the No-D rats showed significantly decreased levels of PGC-1α, a marker of skeletal muscle mitochondrial biogenesis, and DRP1, a marker of skeletal muscle mitochondrial fission. The change in the PGC-1α protein expression and the serum 25(OH)d concentrations were significantly correlated. The change in DRP1 protein expression and the serum 25(OH)d concentrations tended to be correlated. There was no significant between-group difference in markers of mitochondrial fusion (MFN2 and OPA1) and quality control (PARKIN) in soleus muscle, and no relationship with serum 25(OH)d concentrations.

Conclusions: Our findings may indicate that dietary vitamin D deficiency decreased mitochondrial biogenesis and fission in rat soleus muscle.

Keywords: mitochondrial biogenesis, mitochondrial dynamics, PGC-1α, skeletal muscle

Conflicts of interests: none

PAB(T1)-56

Autophagy inhibition induces SREBP1delta-mediated transcription

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Background and objectives: The sterol regulatory element-binding protein 1 (SREBP1) is a transcription factor required for expression of various lipogenic genes. The SREBP1 precursor undergoes proteolytic cleavage at the Golgi apparatus to release the N-terminal nuclear form of SREBP1 (nSREBP1) that transactivates target gene promoters. We previously reported an alternative splicing event that produces SREBP1delta, a constitutively active, nuclear form of human SREBP1 that lacks C-terminal regulatory sequences. The intracellular factors that regulate expression of SREBP1delta are unclear. Here we investigated whether the autophagy system regulates SREBP1delta levels in mammalian cells.

Methods: HEK293 cells transfected with an expression plasmid encoding either precursor or mature SREBP1mRNA were treated with the autophagy inhibitor 3-methyladenine (3-MA; 5 mM) or, as a positive control, a suprapharmacological dose (10 mM) of caffeine, which is reported to increase SREBP1delta expression levels. Immunoblotting was used to assess expression levels of exogenous SREBP1 proteins and LC3 proteins (LC3-I and LC3-II) to monitor the autophagy status of the cells. A luciferase-reporter assay for the SREBP1-responsive glycerol-3-phosphate acyltransferase 1 (GPAT1) gene promoter was conducted to evaluate the function of SREBP1 under the treatments.

Results: Untreated HEK293 cells expressing SREBP1 precursor-mRNA produced exogenous full-length SREBP1 and nSREBP1 protein with no detectable production of the SREBP1delta protein. Treatment of the cells with either 3-MA or caffeine increased levels of both SREBP1delta and canonical nSREBP1. Expression levels of LC3-II, but not of LC3-I, also were increased in the presence of 3-MA or caffeine treatment. However, no further increase in LC3-II was detected in the presence of bafilomycin A1, another inhibitor of autophagy, suggesting that both 3-MA and caffeine suppressed autophagy in the cells. Hence, bafilomycin A1 alone could increase both SREBP1delta and nSREBP1 levels. The luciferase reporter assay showed that 3-MA activated the GPAT1 gene promoter in cells expressing exogenous SREBP1 precursor-mRNA, but not in cells expressing exogenous SREBP1 mature-mRNA that does not undergo alternative splicing and does not produce SREBP1delta protein.

Conclusions: Our results indicated that the inhibition of autophagy could increase cellular lipogenesis by inducing SREBP1delta-mediated transcription.

Keywords: SREBP1, autophagy, transcription factor, 3-methyladenine, caffeine

Conflicts of interests: none

PAB(T1)-57

A valuable tool for measuring skeletal muscle cell contraction force based on the micro-wrinkles on silicone substrate

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Background and objectives: Muscle weakness is leading to increased risks of both physical disability and a wide variety of diseases. No effective drug treatments for muscle weakness have been developed, and one reason for the delay in discovery is that no suitable in vitro screening system has been established to test targeted drugs and supplements. Since a major characteristic of muscle weakness is decreased contractile force, a method that measures the contractile force in myotubes would be a valuable tool to test the effectiveness of muscle-weakness treatments. Here, we constructed a new system for measuring myotube contractile forces evoked by myotube contraction that analyzes the micro-wrinkles on a silicone substrate. We tested the muscle force of a cell model reproducing muscle-weakness disease or hypertrophy to determine whether our system can become a reliable tool for drug and food supplement screening.

Methods: Primary skeletal muscle cells derived from mouse satellite cells were differentiated to myotubes on a two-layer substrate of silicone gel. The myotubes were contracted by an electric pulse, and the contractile force was evaluated by a visualization of the micro-wrinkles and the quantification of the wrinkles' total length. Since the length of wrinkles on the silicon substrate is correlated with the magnitude of the force exerted by cells, we names the wrinkles' length the 'force index.' For an induction of muscle weakness or hypertrophy, myotubes were respectively treated with: dexamethasone, lung cancer cell medium, insulin-like growth factor (IGF)-1, and serum from diabetic mice. We then obtained the force index during electrical stimulation-induced contraction, the myotubes' diameters, and the myosin heavy chain (MHC) protein expression.

Results: The force index in the myotubes treated with dexamethasone, cancer-cell medium, or diabetic mouse serum was significantly decreased, whereas the index in the myotubes treated with IGF-1 was significantly increased. Changes in the force index also reflected atrophic or hypertrophic phenotypes more sensitively than changes in the myotube diameter or MHC expression.

Conclusions: This system is suitable to assess the atrophic and hypertrophic phenotypes of myotubes, which will be useful for the screening of preventive and therapeutic drugs for muscle weakness.

Keywords: skeletal muscle, muscle contraction force, muscle atrophy

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-58

NAFLD milieu alters satellite cell content and muscle regeneration in mice

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Background and objectives: Muscle wasting is a common complication associated with nonalcoholic fatty liver disease (NAFLD). In this study, we investigated the effect of NAFLD on satellite cell (SC) content and skeletal muscle repair.

Methods: Male CD-1 mice fed a choline-deficient diet for 4 weeks were used as a NAFLD model. We performed histological, mRNA expression analyses, western blotting, and immunochemical staining with single muscle fibers to assess the effect of NAFLD on muscle Pax7+ SCs, and muscle regeneration by intramuscular injection of cardiotoxin.

Results: We found that the total number of Pax7+ SCs in the extensor digitorum longus and tibialis anterior muscles of mice with NAFLD was significantly decreased when compared with that in the control group, in which the depletion of the SC pool possibly impaired muscle regeneration, as evidenced by the smaller size of the regenerating myofibers. Importantly, we found that NAFLD significantly impaired the differentiation ability of SCs, as shown by a decreased number of SCs expressing a myogenic marker, MyoD. Finally, this study indicated that molecular mechanisms underlying a decline in SC numbers may be attributed to the upregulation of proinflammatory cytokines (tumor necrosis factor-a [TNFa]) and an oxidative stress marker (NADPH oxidase-2 [NOX2]) in mice with NAFLD.

Conclusions: The findings demonstrate that a decrease in SC content in the skeletal muscle is an important factor that contributes to muscle wasting in NAFLD. Thus, preservation of the muscle SC pool is a potential therapeutic strategy to reduce NAFLD-associated muscle wasting.

Keywords: NAFLD, Muscle atrophy, Satellite cell, Muscle regeneration, Choline-deficient diet

Conflicts of interests: none

PAB(T1)-59

Effects of different energy restriction levels on bone in young female rats

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Background and objectives: An energy intake deficiency impairs bone health. In younger women, the rate of underweight has not improved much, so their bone health is a concern. However, it is unclear at what restriction level of the negative effects occurs, whether there is a threshold for the occurrence, or whether it depends on the level of restriction. Thus, we investigated the effects of different energy restriction levels on bone in young female rats.

Methods: Six-week-old Sprague–Dawley female rats were acclimated for 1 week and then divided into five groups (n = 8 / group): 0%, 10%, 20%, 30%, or 40 % energy restricted. The animals were maintained under these feeding conditions for 10.5 weeks. At the end of the feeding period, blood and bone samples were collected. Bone samples were evaluated for bone mass by the DXA and microstructures by the micro-CT.

Results: By the Jonckheere-Terpstra trend test, significant trends were found between energy restriction and the serum PTH, leptin, and rate of Gla/Glu osteocalcin, the BMD of femur, tibia, and lumbar, and the trabecular thickness and cortical thickness of tibia. Meanwhile, by the Tukey's multiple comparison test, the BMD of tibia in the 0%, 10%, and 20% groups were the same level, but those in the 30% and 40% groups were significantly lower than those in the 0%, 10%, and 20% groups. The BMD of femur in the 40% groups was significantly lower than those in the 10% and 20% groups. However, the serum PTH, leptin, and rate of Gla/Glu osteocalcin were not significantly different among the groups.

Conclusion: Our results suggest that there are dose-response relationships between energy restriction and BMD, bone microstructures, and bone metabolic hormones. Moreover, our results suggest that 30% energy restriction or more decrease BMD in young female rats.

Keywords: Calorie restriction, bone mass, bone quality, bone metabolic hormones

Conflicts of interests: none

PAB(T1)-60

Effects of varying amounts of vitamin B12 and/or folic acid in the diet on the levels of these vitamins present in the liver and plasma homocysteine of rats

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Objectives: Three vitamins, folic acid (FA), vitamin B12 (VB12), and vitamin B6, are involved in intracellular methionine metabolism. We focused on VB12, and FA showing how deficiencies in these vitamins increased plasma total-homocysteine (t-Hcy) levels, a risk factor for cardiovascular disease. The purpose of this study was to investigate whether the accumulated amounts of these vitamins interact with each other (or affect the t-Hcy level in blood plasma) when the intakes of VB12 and/or FA vary.

Methods: Six different experimental diets were prepared with AIN93G (VB12 and FA free) as the base plus the diet combined with methylcobalamin 0.1 or 10 times, and pteroylglulutamic acid 0.1, 1, or 10 times (B12ins-Fdef, B12ins-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Fcnt, B12ins-Fex, B12suf-Fdef, B12suf-Fcnt, and B12suf-Fex). These diets were fed at a rate of 20 g per day to 3-week-old Wistar male rats housed in individual cages for 4 weeks. After feeding, blood and liver samples from each rat were stored at -80°C. The amount of VB12 or FA contained in the liver was quantified by a bioassay using ATCC7830 strain or ATCC7469 strain lactobacillus.

Results and

Conclusions: The amount of VB12 contained in the liver was significantly increased in the B12suf group compared with the B12ins group. However this value was not affected by fluctuations in the amount of FA in the diet. Conversely, the amount of FA accumulated in the liver was significantly increased in rats fed B12suf-Fcnt compared with B12ins-Fcnt, or in B12suf-Fex compared with B12ins-Fex. In other words, when the amount of FA ingested was the same, the amount of FA accumulated in the liver increased in the group ingesting more VB12. Furthermore the plasma t-Hcy level in the B12ins group was significantly higher than that in the B12suf group, and the level was further increased by increasing the amount of FA to the diet. This result suggests that a high level of FA increased non-metabolic FA and decreased the production of 5methy-THF, the methyl group supplier of the methionine synthesis reaction, similar to the findings in the study reported by Koseki et al. (Redox Biology, 37, 101724, 2020).

Keywords: vitamin B12, folic acid, total-homocysteine, rat

Conflicts of interests: none

PAB(T1)-61

Ethanol intake impairs niacin nutritional status in mice

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Background and objectives: Niacin is involved in many biological reactions relating energy metabolism, redox reactions, DNA repair and longevity. Elucidation of the factors affecting niacin requirement is important to maintain niacin nutritional status. Although several factors are considered to increase niacin requirement from biochemical aspects, less direct evidence has shown in vivo. The objective of the present study is to demonstrate factors impairing niacin nutritional status in vivo. We first established model mice to evaluate niacin nutritional status using kynurenine 3-monooxigenase knock out (KMO-KO) mice which lack NAD biosynthesis pathway from tryptophan, and then investigated the effect of ethanol intake on niacin nutritional status.

Methods: To determine the niacin requirement, 4 weeks old KMO-KO mice were fed 2–30 mg/kg nicotinic acid containing diets for 28 days. To evaluate the effect of ethanol intake, 4 weeks old KMO-KO mice were fed 4 or 30 mg/kg nicotinic acid containing diets with or without 15% ethanol for 35 days. Body weight, NAD related compounds in the blood, liver and urine, and NAD metabolism related enzyme activities in the liver were measured.

Results: The mice fed less than 3 mg/kg nicotinic acid containing diets showed growth retardation, low niacin nutritional markers in the blood, liver and urine. These results showed that niacin requirement for maximum growth is 4 mg/kg nicotinic acid containing diet in the KMO-KO mice. The mice fed 4 mg/kg nicotinic acid containing diet with 15% ethanol showed lower body weight gain, blood and liver NAD, and urine nicotinamide metabolites than in the mice fed the same diet without ethanol. These animals also showed lower enzyme activities in the NAD salvage pathway but not nicotinamide catabolic pathway. Ethanol intake did not affect any indices in the mice fed 30 mg/kg nicotinic acid containing diet.

Conclusion: We established the model mice to evaluate niacin nutritional status. The present study also suggest that ethanol intake impaired niacin nutritional status by enhancement of NAD consumption and suppression of NAD reuse.

Keywords: nutritional status, NAD, model mice, alcohol intake, vitamin

Conflicts of interests: none

PAB(T1)-62

Divergent effects of dietary fatty acids on postprandial exosome functionality and their proteomic profile

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Background and objectives: Circulating exosomes are small phospholipids-rich vesicles that contribute to intercellular communication and are promising biomarkers of several disease onset and progression. Diet is a cornerstone for disease prevention, but postprandial dietary fatty acid effects on exosome structure and functionality are poorly characterized. We aimed to determine the role of different dietary fatty acids on postprandial exosome functionality and proteomic profile.

Methods: Healthy subjects were given a 15 calorie per kilogram of body weight meals containing either SFAs, MUFAs, MUFAs plus omega-3 LCPUFAs or no fat. Blood samples were collected at baseline, at postprandial peak (2-3 h), and at postpeak (6 h) for analysis. Exosomes were isolated from 1 mL of plasma by an ultracentrifugation method. Purified exosomes were lysed and analysed with the Orbitrap Fusion high-resolution mass spectrophotometer fronted with a NanoESi ion source. Vesicle size was determined by nuclear magnetic resonance and transmission electron micrograph. To evaluate exosome functionality, PBMCs were incubated with or without postprandial exosomes for 24 hours and their effects were analysed by RT-qPCR.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Results: In general, there were over 200 proteins identified by Orbitrap MS in exosome lysed-containing fraction. In this set of exosome-related proteins, there were 31 proteins associated with different immune-related functions in this set, which putatively reflected the major role of exosomes released by immune cells present in the blood. At postprandial hypertriglyceridemic peak, exosome lysed-containing fraction skewed toward a proinflammatory profile and increased the mean particle size. Moreover, postprandial exosomes rich in SFAs made polarized macrophages prone to an M1-like phenotype. In contrast to dietary SFAs, exosomes-derived dietary MUFAs primed circulating monocytes for a reduced postprandial pro-inflammatory profile.

Conclusions: Our findings imply a new understanding of the mechanisms by which dietary fatty acids remodel proteomic cargo in postprandial exosomes. This study demonstrates that the intake of a meal enriched in MUFAs from olive oil, when compared with a meal enriched in SFAs, prevents the postprandial production and priming of circulating pro-inflammatory monocytes and low-grade systemic inflammatory response.

Keywords: Postprandial Metabolism, Hyperlipidemia, Extracellular Microvesicles, Exosomes, Proteomic

Conflicts of interests: none

PAB(T1)-63

Taurocholic acid, a primary 12α-hydroxylated bile acid, induces leakiness in the distal small intestine in rats

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Background and objectives: High-fat diets (HFD) increase 12α-hydroxylated (12αOH) bile acid (BA) secretion, of which high fecal level of deoxycholic acid (DCA), a secondary 12αOH BA, has been reported responsible for the leaky gut. Our previous studies have associated HFD with an elevated concentration of taurocholic acid (TCA), a primary 12αOH BA, in the enterohepatic circulation in rats. However, it is unclear whether primary 12αOH BAs play a role in gut barrier impairment.

Methods: To address this question, rats were fed either a control diet or a diet supplemented with cholic acid (CA) (0.5 g/kg diet) for 13 weeks. The relationship between fecal BA profiles and gut permeability was examined every 2 weeks. Changes in genes related to barrier function were compared in ileal and colonic epithelia. Furthermore, rats fed the same diets were administered vancomycin (200 mg/L drinking water) for 6 weeks. Besides, based on the luminal BA concentrations, ex vivo gut leakiness was determined in the Ussing chambers.

Results: CA diet elevated the concentrations of TCA in the small intestine and DCA in the large intestine, which shared great similarity with the BA environment in the body under high-fat intake. Gut permeabilization was initially observed at 2 weeks. Higher fecal 12αOH/non-12αOH BA ratio was associated with gut permeability in multivariate analysis, of which primary BAs correlated with gut permeability in the early phase and secondary BAs in the latter phase. At the end of the feeding period, the CA diet enhanced the phosphorylation of myosin light chain 2 and reduced claudins and antimicrobial peptides expression in the ileal but not colonic epithelia. Notably, the CA diet-induced gut leakiness was not influenced by the coadministration of vancomycin, which suppressed secondary BAs production. Portal TCA concentration was closely correlated with gut permeability ($r = 0.7388$, $P < 0.0001$). In the Ussing chambers, DCA moderately increased permeability in the large intestine, whereas TCA considerably increased the ileal but not jejunal permeability. A Rho kinase inhibitor attenuated TCA-induced ileal permeability.

Conclusions: Overall, the present study demonstrated the significance of TCA, the primary 12αOH BA, in proximal gut leakiness.

Keywords: Bile acid, Gut permeability, Enterohepatic circulation, Ileum, Rats

Conflicts of interests: none

PAB(T1)-64

Zinc deficiency alters zinc transporters in rat tissues

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Background and objectives: Zinc (Zn) is an essential trace metal required for the catalysis or structural stabilization of over 300 enzymes. Zn homeostasis is primarily maintained by regulation of its influx into cells and efflux out of cells. Several Zn transporters are expressed in various tissues. There are two families of Zn transporters in humans, the Slc39a (Zip) family, with 14 members, and the Slc30a (ZnT) family, with at least 10 members. The Zip family of transporters mediates Zn uptake, whereas the ZnT family of transporters mediates Zn export. However, it is unclear whether dietary Zn deficiency affects alteration of Zn transporters in tissues.

Methods: After a 3-day adaptation period with control diet (30 mg Zn/kg), rats were randomly divided into the control (C) group (n = 8) and the Zn deficiency (ZD) group (n = 8). Rats in the ZD group were provided ad libitum access to a Zn-deficient diet, while those in the C group were pair fed with the control diet to the mean intake of the ZD group. After 1 week of treatment, rats were fasted for 12 h and euthanized for dissection. Blood, duodenum, liver, kidney, and bone samples were collected for analysis.

Results and Conclusions: The serum Zn concentration was significantly lower in the ZD group than in the C group. The mRNA expression of Zn uptake transporter genes, such as Zip1 (in the kidney) and Zip4 (in the duodenum), was significantly increased in the ZD group compared to that in the C group. However, the mRNA expression of the Zn export transporter gene ZnT1 was

significantly decreased in the ZD group compared to that in the C group only in the kidney. These results suggested that the mRNA expression of Zn transporters in several tissues quickly responded to dietary Zn deficiency.

Keywords: Zinc, Zinc transporter

Conflicts of interests: none

PAB(T1)-65

In vitro impact of plant-based protein isolates on hepatic endoplasmic reticulum-mitochondria interactions and insulin sensitivity.

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Background and objectives: Metabolic flexibility is the ability of our organism to switch from fatty acid oxidation to enhanced glucose metabolism between fasted and fed states. Metabolic inflexibility induces hepatic lipid accumulation and insulin resistance, in part through a reduction of Endoplasmic Reticulum (ER)-mitochondria contact sites called mitochondria-associated membranes (MAMs)[i]. Some nutrients can regulate MAMs in the liver impacting metabolic flexibility. Therefore, identifying new nutritional strategies improving MAMs may be useful to prevent metabolic diseases. Here, we aimed at identifying plant-based protein prototypes able to stimulate MAMs and insulin sensitivity in vitro in HuH7 liver cells.

Methods: 1/ HuH7 cells, cultured in presence of bovine serum albumin (BSA, as control) or of palmitate (200µM) to induce metabolic alterations, were co-incubated for 24 hours with 12 protein isolates, beforehand submitted to an in vitro simulated gastrointestinal digestion. ER-mitochondria interactions were analyzed by in situ Proximity Ligation Assays (PLA) and insulin signaling was accessed by measuring insulin-stimulated AKT/PKB phosphorylation. 2/ The impact of 2 selected digests (1mg/ml) on mitochondria dynamics (immunohistochemistry) and function (oxygen consumption) and on lipid accumulation (bodipy staining) was further investigated in both conditions.

Results: 1/ 5 digests were identified as increasing hepatic MAMs and improving insulin signaling in HuH7 cells in lipotoxic conditions. 2/ Pea and fava bean protein digests were selected and their effects on MAMs and on insulin signaling were confirmed. They both prevented palmitate-induced reduction of MAMs (no effects in basal conditions). Moreover, pea protein digest significantly increased insulin signaling at both basal and palmitate stimulated conditions, whereas fava bean protein digest only prevented deleterious effect of palmitate on insulin signaling. Lastly, pea and fava bean protein digests improved both palmitate-induced mitochondria fission and palmitate-induced lipid accumulation.

Conclusion: Altogether, these data highlight beneficial effects of pea and fava bean protein digests on ER-mitochondria interactions, mitochondria dynamic, lipid accumulation and insulin signaling in HuH7 cells. This allows to identify potential candidates for preventive and/or therapeutic nutritional interventions in at-risk populations (obese or at metabolic risk).

Keywords: hepatic cells, lipotoxicity, ER-mitochondria interaction, mitochondrian insulin sensitivity, plant-based proteins

Conflicts of interests: Roquette is the sponsor of this study

Further Collaborators: Juliette Caron, formerly working at Roquette, is a co-author of this work.

PAB(T1)-66

Current state and issues of laboratory nutrition analysis for food nutrition labeling in Japan: an assessment of performance data from proficiency testing schemes in 2017-2021

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Background and Objective: Reliable laboratory analysis is essential for correct nutrient declaration for processed foods. Thus, we have provided a proficiency testing (PT) scheme once per year for food nutrition analysis in Japan. This study aimed to clarify analytical precision for mandatory nutrients or others.

Methods: PT rounds were conducted in accordance with ISO/IEC 17043 requirements. We reviewed the results of the PT rounds in 2017-2021 and calculated reproducibility relative standard deviation (RSDR) values to evaluate variation between laboratories.

Results: The number of participating laboratories in each PT scheme ranged from 65 to 89, and more than 65 % of the participants were public organizations responsible for a nutrition-labeling compliance test. The laboratories reporting inadequate analytical values (i.e. z-score ≧ 3 and/or percentage difference >; 20 %) in one or more nutrients for mandatory declaration (energy, protein, fat, carbohydrate, or salt equivalent) ranged from 5 to 18 % of all participants. In the PT in 2017-2018, the food matrices were pork and chicken sausages, and the approximate RSDR values were as follows: protein, 2 %; fat, 3-4 %; ash, 2 %; moisture, 0.4-0.7 %; carbohydrate, 8-9 %; energy, 1-2 %; sodium (salt equivalent), 4 %, calcium, 8 %; and iron, 8 %. On the other hand, in the PT in 2019-2021, the food matrices were grain cereals, and the approximate RSDR values were as follows: protein, 2-3 %; fat, 5-9 %; ash, 2-3 %; moisture, 6-18 %; carbohydrate, 1 %; energy, 1 %; sodium (salt equivalent), 4-26 %; dietary fiber, 4-12 %; calcium, 5-6 %; iron, 5-9 %; copper, 12 %; and potassium, 5 %.

Conclusions: In many cases, variations of reported values between laboratories were less than 10 % as RSDR, suggesting

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

the good performance of the participants. However, large RSDR values were observed in cases where nutrition contents were relatively low. Hence, regulatory authorities need to consider these variations between laboratories to make a proper judgment in compliance tests.

Keywords: nutrition analysis, mandatory nutrition labeling, proficiency testing schemes, compliance test, standard deviation for proficiency assessment

Conflicts of interests: none

PAB(T1)-67

Interaction between the content of HDL and non HDL in EPA, DHA and some apolipoproteins and the severity of hormone receptor negative breast cancer.

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Background and objectives: We have shown previously that the severity of hormone receptor negative breast cancer, as assessed by Ki-67 level, is negatively related to the HDL content in apolipoprotein (apo) C-1 and the non HDL content in apo C-2 and positively related to the HDL content in apo D (J. Clin. Med. 2022, 11, 1345). It has been suggested that circulating long chain omega 3 fatty acids (EPA and DHA) may influence breast cancer disease. The present sub-study was undertaken to determine if the EPA and DHA content of HDL and non HDL could influence this relationship.

Methods: 48 EDTA plasma samples drawn from receptor negative breast cancer patients were collected from our biobank at Institut de Cancérologie de l'Ouest, Saint-Herblain, France. Apolipoproteins and EPA/DHA content of HDL and non HDL was determined by LC-MS chromatography before and after precipitation of apo B containing lipoproteins. The relationship between the content of HDL and non HDL in apo and EPA or DHA was established by correlation analyses. Univariate and multivariate logistic regression models were used to establish the association between the content of HDL and non HDL in apo or EPA/DHA and the level of Ki-67 (high Ki-67 ≧30% or low Ki-67 ≦20%).

Results: HDL apo C-1 and HDL apo D were not significantly correlated with either HDL EPA nor HDL DHA, while non HDL apo C-2 was highly correlated with the non HDL content in EPA (p<;0.001) and not DHA (p =0.106). The tumor Ki-67 level was highly correlated with non HDL EPA (<;0.001 [<;0.001-0.026], p=0.029; odds ratio (OR) [95% Wald confidence interval], high Ki-67 vs low Ki-67) in univariate analysis. In the multivariate analysis, HDL apo D remained significantly associated with high Ki-67 (OR=6.66 [1.33-33.43], p=0.021. A tendency was observed for non HDL EPA (OR<;0.001 [<;0.001-1.88], p=0.070) and HDL apo C1 (OR=0.21 [0.04-1.14], p=0.071). Non HDL apo C-2 lost its significance (OR=0.12 [0.01-2.21], p=0.152).

Conclusions: Non HDL EPA seems to be associated to a lower risk of having a high proliferative index tumor. However, this effect could partly depend on its interaction with lipoprotein composition in apolipoproteins.

Keywords: breast cancer, EPA, apolipoprotein, HDL, DHA

Conflicts of interests: none

PAB(T1)-68

Search for ornithine decarboxylase expression regulation mechanism and polyamine synthesis mechanism by FOXO1

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Background and objectives: FOXO1 is a transcription factor whose expression is increased by starvation and inactivity. FOXO1 transgenic (FOXO1-Tg) mice with skeletal muscle specific overexpression of FOXO1 demonstrated significant muscle atrophy. We have previously found that the expression of ornithine decarboxylase (Odc1) was increased in the skeletal muscle of FOXO1-Tg mice by comprehensive gene expression analysis. Odc1 controls the rate of limiting steps of polyamine synthesis. Polyamines promote cell proliferation, nucleic acid and protein synthesis. On the other hand, it has been reported to activate cell autophagy. The relationship between the role of polyamines, ornithine decarboxylase and muscle atrophy has not been clarified. Therefore, we focused on FOXO1 that increases during skeletal muscle atrophy and analyzed the mechanism of Odc1 expression regulation during muscular atrophy.

Methods, results, and discussion: Gene expression analysis was performed using skeletal muscle samples of mice under the condition of skeletal muscle atrophy with increased FOXO1 expression (FOXO1-Tg mice, fasted mice, plaster-casted mice, denervated mice). The expression of Odc1 was increased under these skeletal muscle atrophy conditions. On the other hand, in mice lacking FOXO1, 3a, 4 specifically in skeletal muscle, Odc1 expression was not increased during fasting. These results suggest that Odc1 expression increases under muscular atrophy conditions in which FOXO1 expression increases. In addition, we have conducted comprehensive analysis of muscle metabolites in FOXO1-Tg mice using CE-TOFMS. As a result, putrescine, which is a type of polyamine was increased in the muscle of FOXO1-Tg mice, indicating that FOXO1 may increase polyamines in skeletal muscle. Consequently, it is possible that Odc1 is the target gene for FOXO1 and FOXO1 regulates intracellular polyamine synthesis.

Keywords: muscle atrophy, FOXO1, ornithine decarboxylase

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-69

Gut commensals regulate intestinal mucosal immunity through microRNA-200 gene silencing in lamina propria leukocytes of murine large intestine

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Background and objective: Gut microbiota plays important roles in development and homeostasis maintenance of immune system. MicroRNAs (miRNAs) are small noncoding RNAs that suppress the expression of target genes post-transcriptionally and involved in a variety of physiology including intestinal immune system. However, the role of miRNAs in gut microbiota regulation of intestinal immune system is not fully understood. We investigated the effect of gut microbiota on the miRNA expression and intestinal immunity in mice.

Methods: We compared the expression profiles of miRNAs and mRNAs in lamina propria leukocytes (LPL) in the large intestines of germ-free (GF) and specific pathogen-free (SPF) mice using microarray. A gene ontology enrichment analysis was done using DAVID on the mRNAs in which the expression levels were lower in SPF mice than in GF mice. Target genes of miRNAs in which the expression levels were higher in SPF mice than in GF mice were predicted by TargetScan. Expression level of target genes and their translational products ware analyzed by RT-qPCR and western blotting, respectively. Interleukin (IL)-2 production in cultured LPL upon stimulation with phorbol 12-myristate 13-acetate and ionomycin was measured by ELISA. In separate experiments, miRNA expression in large intestinal LPL was investigated in mice supplemented with 4% (w/v) 1-kestose (KES) in drinking water and mice administered with Bifidobacterium pseudolongum.

Results: By comparing SPF and GF mice, we found that the presence of gut microbiota increased the expression of miR-200 family members and decreased the expression of their target mRNAs, i.e., Bcl11b, Ets1 and Zeb1, in large intestinal LPL. Bcl11b and Ets1 reportedly encode transcriptional factors activating Il2 gene. Indeed, the presence of gut microbiota reduced IL-2 production in cultured LPL. We also showed that KES feeding and B. pseudolongum administration increased the expression of miR-200 family members in large intestinal LPL.

Conclusions: Considering that BCL11B and ETS-1 function as transcription factors to activate the Il2 gene, we propose that the presence of gut commensals, especially B. pseudolongum suppresses IL-2 production in large intestinal LPL, at least in part through post-transcriptional downregulation of Bcl11b and Ets1 genes by miR-200 family members.

Keyword: Gut microbiota, microRNA, prebiotics, probiotics

Conflict of Interest Disclosure: Y Kadota and T Tochio are employees of B Food Science Co. Ltd, which is the producer of 1-kestose used in this study.

PAB(T1)-70

Bifidobacterium breve supplementation during infancy attenuates mobility in low-birthweight rats during adolescence.

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Background and Objectives: Children with low birthweight (LBW) have a higher risk for developing attention-deficit/hyperactivity disorder (ADHD), for which no prophylactic measure exists. The gut microbiota in infants with LBW is different from that in infants with normal birthweight and is associated with ADHD. Oral supplementation with Bifidobacterium has several health benefits, such as suppressing inflammation and reducing infectious disease in newborns with LBW. We hypothesized that early oral administration of B. breve can attenuate altered behaviors observed later in life in individuals born with LBW. The aim of the present study was to investigate whether oral administration of B. breve M-16V in the neonatal and infantile periods has beneficial effects on behaviors during adolescence in rats born with LBW.

Methods: We examined the effect of gavage supplementation with Bifidobacterium breve M-16V in a rat model of intrauterine hypoperfusion. Pups born with LBW were supplemented with either B. breve or vehicle from postnatal days 1 to 21.

Results: The open-field test at 5 weeks of age (equivalent to human pubertal age) showed that rats in the LBW-vehicle group were marginally hyperactive compared with rats in the sham group, while rats in the LBW-B.breve group were significantly hypoactive compared with rats in the LBW-vehicle group. The gut microbiota in the LBW-vehicle group wasdifferent from that in the sham group, while that in the LBW-B.breve group was not. Anatomical/histological evaluation at 6 weeks of age demonstrated that the brain weight and the cerebral areas on coronal sections were reduced in the LBW groups compared with the sham group. Probiotic supplementation did not ameliorate these morphological brain anomalies in LBW animals. The percentage of Iba-1+ cells in the brain was not different among the LBW-B.breve, LBW-vehicle, and sham groups.

Conclusions: B. breve supplementation during early life is suggested to have the potential to help children with LBW attenuate hypermobility in adolescence, although caution is warranted when extrapolating the data on rodent behaviors to children with neurodevelopmental disorders. [Conflict of Interest Disclosure]

Keyword: Bifidobacterium breve M-16V, fetal growth restriction, gut microbiota, low birthweight, spontaneous activity

Conflict of Interest Disclosure: The authors disclose that this research was partially financially supported by Morinaga Milk Industry Co., Ltd. and was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-71

High-intensity exercise and low dietary intake significantly alter iron metabolism involving hepcidin

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Background and Objectives: The amount of food intake and digestive tract function is known to decrease during intense exercise, and many athletes consume high energy but do not consume food. However, there are a few direct studies on the relationship between the degree of malnutrition (mild to severe) and exercise-induced anemia. The purpose of this study was to observe changes in iron metabolism of rats due to high-intensity exercise during reduced food intake.

Methods: Thirty-six, 4-wk-old male Wistar rats were divided into six groups after being acclimated to running: rested control, intense exercise, 80% feeding and rested, 80% feeding and intense exercise, 70% feeding diet and rested, and 70% feeding and intense exercise groups. Only three intense exercise groups underwent acute running sessions for 30 min (30 m/min) once a day for 7 d.

Results: Rats did not develop anemia with exercise and food intake restriction. Serum iron levels, transferrin saturation, hepcidin-25, and hepatic iron levels in the exercise groups were lower than those in the respective resting groups. However, these values in the 70% diet groups were slightly higher than those in the 80% diet groups. Serum erythropoietin levels decreased as food intake decreased, but the serum erythropoietin level in the 70% feeding and intense exercise group was similar to that in the rested control group. Serum interleukin-6 levels were significantly lower in the groups with restricted food intake than in the free-fed group, and exercise had no effect.

Conclusions: High-intensity exercise under restricted food intake may significantly alter the iron metabolism to maintain blood cell levels due to the strong promotion of metabolic iron utilization in response to dietary iron depletion, increased iron demand, and excretion.

Keywords: Anemia, Iron metabolism, Exercise, Dietary intake, Hepcidin

Conflicts of interests: none

PAB(T1)-72

Rice bran combined with tea seed oil may modulate the liver steatosis and gut microbiota in neuroinflammatory ovariectomized mice

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Background and objectives: The oxidative stress and inflammation alter the blood-brain barrier permeability, which induces insulin resistance and interfere with the microbiota distribution, especially in postmenopausal estrogen deficiency condition. Dietary rice bran and tea seed oil were thought to benefit the brain with their multiple effects on anti-oxidation, anti-inflammation, blood glucose homeostasis, and gut microbiota modulation. This study aimed to investigate the influence of rice bran, and tea seed oil on the gut-liver-brain axis in high fructose (HF) drink fed ovariectomized (OVX) mice with D-galactose (D-gal) injection.

Methods: Eight weeks old young female C57BL/6 mice and 6-8 months old female mice were assigned into six groups: sham + young mice (SY), sham + old mice (SO), OVX + soybean oil diet (OS), OVX + soybean oil combined rice bran diet (OSR), OVX + tea seed oil diet (OT) and OVX + tea seed oil combined rice bran diet (OTR). Four OVX groups were given D-gal (100 mg/kg/day) by s.c. and 15% (v/v) fructose drink for 8 weeks. The rice bran and tea seed oil contents were 10% (w/w) in the modified AIN-93M experimental diet. Results The hepatic TG and TC content, the plasma AST and ALT level, and the relative abundance of endotoxin-producing gut f_Tannerellaceae significantly increased in the OT group. The relative abundance of f_Tannerellaceae in the cecum was positively associated with pro-inflammatory cytokines, hepatic lipids, and the plasma AST and ALT. The above results show the correlation of the brain-liver-gut axis. The alteration of gut microbiota and increased fecal butyrate production in the OTR group could lower the hepatic lipids, the plasma AST, ALT, and 8-OHdG level. These might alleviate the neuroinflammation of the brain. Conclusions Rice bran may ameliorate the fatty liver and inflammation through downregulating circulating 8-OHdG and the gut f_Tannerellaceae level in this neuroinflammatory OVX mice model.

Keywords: neuroinflammation, brain-liver-gut axis, rice bran, tea seed oil, ovariectomized mice

Conflicts of interests: none

Further collaborators: Professor Hitoshi Shirakawa, Tohoku University, Japan

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-73

Dietary biotin supplementation increases energy expenditure via interscapular brown adipose tissue activation in rats

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Background and objectives: Biotin is a water-soluble vitamin functioning as a cofactor for biotin-dependent carboxylases. Our previous study indicated that short-term, high-dose dietary biotin intake increases energy expenditure, fat oxidation, and liver carnitine palmitoyl transferase (CPT) activity in Sprague–Dawley (SD) rats. However, the biotin concentration in the experimental diet was higher than the recommended safe dose, with a short biotin-supplementation period. Therefore, in this study, we evaluated the effect of long-term and safe dosage of dietary biotin supplementation on energy metabolism and its mechanism in rats.

Methods: Five-week-old male SD rats were fed AIN-93G and biotin-supplemented diets of three different concentrations (0.004%, 0.020%, and 0.080% of diet) for 9 weeks. Respiratory gas analysis was conducted at weeks 2, 4, and 8. The rats were sacrificed at 14 weeks of age, and plasma, liver, interscapular brown adipose tissue (iBAT), mesenteric white adipose tissues (mWAT), and gastrocnemius muscle (GM) were collected. Body weight, energy metabolism, biochemical parameters in plasma and liver, CPT activity, gene expression, and biotin concentrations were assessed.

Results: In the 0.080% biotin group, a decrease in body weight and an increase in energy expenditure were identified after week 2. Fat oxidation elevated in the 0.080% biotin group at weeks 2 and 4; however, carbohydrate oxidation remained unchanged. In the 0.080% biotin group, triglyceride levels in the plasma and liver decreased and plasma adiponectin concentration increased. CPT activities in the liver and iBAT were elevated in the 0.080% biotin group, whereas those in mWAT and GM were the same among the dietary groups. In the 0.080% biotin group, gene expressions of Cpt2, acyl-CoA oxidase 1, long-chain acyl-CoA dehydrogenases, peroxisome proliferator-activated receptor-gamma coactivator-1α were increased in iBAT and uncoupling protein 1 gene expression was tended to increase. These gene expressions in the liver were not different between the dietary groups. Biotin concentrations of iBAT increased in the 0.080% biotin group, whereas those in the liver remained unchanged.

Conclusions: These results suggest that long-term and safe dosage of dietary biotin supplementation increases energy expenditure via activation of iBAT. This may be due to a high level of biotin accumulation in iBAT.

Keywords: Biotin, Energy expenditure, Fat oxidation, Interscapular brown adipose tissue, Carnitine palmitoyl transferase

Conflicts of interests: none

PAB(T1)-74

Prematurity alters the regulation of insulin signaling to protein synthesis in skeletal muscle

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Background and objectives: Postnatal growth faltering is common after preterm birth and is associated with reduced lean mass accretion. Recently we showed in a preterm piglet model that premature birth impairs normal postnatal weight gain and the protein synthesis response to feeding in skeletal muscle. Because the increase in muscle protein synthesis with feeding in the neonate is driven, in part, by the rise in insulin after a meal, the objective of this study was to identify key regulators in the insulin signaling pathway that are responsible for the blunted anabolic response to feeding in skeletal muscle of the preterm.

Methods: Piglets delivered by Cesarean section 11 d (preterm; equivalent to 32 weeks human gestational age) or 2 d (term) before term birth were fed by total parenteral nutrition. On day 3, after 4 h fasting, piglets were fasted one additional h or fed orally a milk replacer meal (per kg body weight: 31.5 kcal, 1.3 g carbohydrate, 2.7 g amino acids, and 1.6 g lipid). Positive and negative regulators of insulin and translation initiation signaling in longissimus dorsi muscle were determined by Western blot.

Results: Feeding increased the phosphorylation of positive regulators of the insulin signaling pathway, i.e., Akt1, Akt 2, PDK1, and mTORC2, leading to an increase in the phosphorylation of mTORC1 and downstream regulators of translation initiation, i.e., 4EBP1 and S6K1 (P<;0.05) in skeletal muscle of pigs born preterm and at term. However, prematurity blunted the feeding-induced activation of these positive regulators of insulin signaling and translation initiation (P<;0.05). The abundance of inhibitors of insulin signaling, PHLPP and SHIP2 were higher in muscle of preterm than in term (P<;0.05).

Conclusions: These results show that the feeding-induced activation of positive regulators of insulin signaling is reduced by preterm birth, whereas the abundance of negative regulators is enhanced. Our findings suggest that premature birth impairs the activation of insulin signaling that is essential for channeling dietary nutrients for anabolism. This attenuated response likely contributes to the postnatal growth faltering of prematurity.

Keywords: Preterm, Muscle, Pediatrics, Insulin, Protein synthesis

Conflicts of interests: none

Source of Research Support: NIDDK HD085573 and USDA CRIS 3092-51000-060.

PAB(T1)-75

Effects of Chronic L-α-glycerylphosphorylcholine (α-GPC) Ingestion on Spatial Memory in Adult Male Rats

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Background and objectives: Chronic α-GPC intake is known as an enhancer of memory. However, the molecular mechanism of this improvement is still unclear. Studies investigating the effect of α-GPC on memory in animal models have focused on juvenile or elderly animals, but not on adults. Thus, the purpose of this study is to determine whether chronic feeding of α-GPC in the diet of healthy adult rats can improve their spatial memory, and to identify the molecular mechanism underlying any α-GPC-induced memory improvement.

Methods: Twenty-four 10-week-old male Wistar-Imamichi rats were divided into two equal-sized groups. One group (SUP) received a special diet containing 1.5 % α-GPC of total diet weight, while the other group (STA) were fed a standard diet. Water and food were available ad libitum throughout the experiment. At 20 weeks of age, all rats underwent a spontaneous place recognition (SPR) test. Each rat was exposed to two identical objects, and then after a retention interval of 24 hours, they were tested with one of the objects moved to a novel location. The SPR test utilizes the tendency of rats to explore novelty, so if the rats remember the original object location, they would tend to explore the novel object's location in the test. After the SPR tests, microarray analysis was conducted on the hippocampal formation taken from all the rats.

Results: In the SPR test, the SUP group showed a preference for the novel object location, but the STA group did not. Microarray analysis showed some differences in gene expression in hippocampal formation between the SUP and STA groups. These results indicate that these genes could be associated with memory ability, supporting the results of previous studies.

Conclusions: We found that chronic α-GPC ingestion improved the spacial memory of rats, and could change a molecular mechanism underlying spatial memory depending on hippocampus.

Keywords: α-GPC, memory, rat

Conflicts of interests: none

PAB(T1)-76

Development of measurement system for fructose-derived AGE, glucoselysine, in human serum

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Background and objectives: Metabolic disorders progress by unbalanced lifestyles such as excessive intake of nutrients and lack of exercise, carbohydrates in our body are nonenzymatically react with proteins to form advanced glycation end products (AGEs). Accumulation of AGEs is increased in normal aging, and enhanced by the unfavorable lifestyle and pathogenesis of diabetes. Thus, the measurement of AGEs is expected as a predictive marker for diabetic complications. When hyperglycemia is prolonged, the glycolysis system becomes saturated then promotes glucose metabolism via the polyol pathway, resulting in the production of fructose. Glucoselysine (GL), one of AGEs, is produced by the reaction of fructose with lysine residues on proteins, resulting in the production of various denatured proteins in our body. However, the measurement system for GL in blood has not been developed yet. The present study aimed to develop a measurement system for GL in serum.

Methods: Human serum was filtered by a molecular-weight 3,000 cut filter to collect free GL and GL-modified peptides, and then acid hydrolysis was performed. The hydrolysate was applied to a cation exchange column and eluant was analyzed by liquid chromatography-tandem mass spectrometry (LC-MS/MS).

Results: the precursor ion of GL was m/z 309, and the fragment ion of m/z 210 was detected in serum samples, indicating that GL is detectable in peripheral blood samples.

Conclusions: It is expected that the change in the involvement of the polyol pathway between healthy subjects and diabetic patients, and the progression of diabetic complications can be evaluated by monitoring GL in the future.

Keywords: AGEs, glucoselysine, hyperglycemia, diabetes, polyol pathway

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-77

Synergistic effect of exercise training and linoleic acid supplementation on tetra-linoleoyl cardiolipin biogenesis in skeletal muscles

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Background and objectives: Cardiolipin (CL), localized mainly to the mitochondrial inner membrane, is a unique glycerophospholipid with two phosphate headgroups and four acyl chains. Tetra-linoleoyl CL (CL (18:2)4) is the dominant CL species in skeletal muscles. Accumulated evidence suggests that the intercellular fatty acyl environment could affect cardiolipin composition. In particular, the cellular balance of linoleoyl (18:2) and oleoyl (18:1) residues in phospholipids (PL) (18:2-PL/18:1-PL ratio) is of pivotal importance for CL (18:2)4 content. Exercise training is widely known to enhance mitochondrial biogenesis. Interestingly, CL (18:2)4 biosynthesis may be associated with mitochondrial biogenesis; however, the exercise training effect on CL (18:2)4 content and intercellular 18:2-PL/18:1-PL ratio in skeletal muscles remain elusive. In this study, we investigated whether exercise training could increase the CL (18:2)4 content via changing the 18:2-PL/18:1-PL ratio. Moreover, since mammals cannot biosynthesize linoleic acid, dietary intake of linoleic acid may strongly affect the intercellular 18:2-PL/18:1-PL ratio. Therefore, we also verified whether linoleic acid supplementation during exercise training enhanced the beneficial effects of exercise by increasing CL (18:2)4 content.

Methods: C57BL/6J mice, classified into the sedentary (Sed) and exercise training (Tr) groups, were fed with oleic acid-rich (OA) and linoleic acid-rich (LA) diets, respectively. The PL composition and activities of citrate synthase (CS) and mitochondrial respiratory chain in skeletal muscles were measured 2 weeks after exercise training and dietary intervention.

Results: The 18:2-PL/18:1-PL ratio and CL (18:2)4 content in skeletal muscles were 5.4- and 2.5-fold higher, respectively, in the Sed-LA group than those in the Sed-OA group and even higher in the Tr-LA group but not observed in the Tr-OA group. The training-induced increase in CS activity was observed in both Tr-OA and Tr-LA groups. Mitochondrial respiratory chain activity in the Sed-LA group was higher than that in the Sed-OA group and even greater in the Tr-LA group.

Conclusions: This study showed that linoleic acid supplementation with exercise training increased the 18:2-PL/18:1-PL ratio and CL (18:2)4 levels and improved mitochondrial function in the skeletal muscles. Thus, simultaneous linoleic acid supplementation with exercise training was necessary for these effects.

Keywords: Cardiolipin, Phospholipid, Mitochondria, Exercise, Linoleic acid

Conflicts of interests: none

PAB(T1)-78

Dietary protein restriction increases plasma soluble leptin receptor levels and suppresses the appetite-reducing effect of administered leptin

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Background and objectives: Leptin, a hormone secreted by the adipose tissue, suppresses appetite and regulates body fat mass. We found that the liver leptin receptor (Ob-R) mRNA and plasma soluble Ob-R (sOb-R) levels increased in mice fed a low-protein diet. In this study, we investigated the physiological function of increased plasma sOb-R on leptin action by administering leptin to low-protein diet-fed C57BL/6J and ob/ob mice.

Methods: Four-week-old C57BL/6J mice and 7-week-old ob/ob mice were fed a control diet with 20 % protein or a low-protein diet (with 5 % protein for C57BL/6J mice or 1 % protein for ob/ob mice) for 11 days. On the last four days, 2 mg/kg leptin was intraperitoneally injected into half of the mice in each diet group, and the vehicle was injected into the other half. Five hours after the last injection, the mice were dissected, and blood and organ samples were retrieved.

Results: Hepatic Ob-R mRNA levels were increased, and Ob-R protein levels were decreased by protein restriction in both C57BL/6J and ob/ob mice. Plasma sOb-R concentration was increased by protein restriction in C57BL/6J mice but not in ob/ob mice. The appetite-suppressing effect of leptin was decreased in mice fed a low-protein diet in C57BL/6J mice, but not in ob/ob mice. The mRNA levels of genes involved in appetite regulation were altered in response to leptin administration in both diet groups in ob/ob mice, whereas alterations in the expression of these genes could not be detected in C57BL /6J mice.

Conclusions: Plasma sOb-R levels did not increase in ob/ob mice, which demonstrates that the presence of normal leptin was required to increase plasma sOb-R levels during protein deficiency. The absence of increased sOb-R levels may be responsible for the lack of suppression of leptin action in ob/ob mice, indicating that increased sOb-R levels may suppress leptin action.

Keywords: soluble leptin receptor, protein restriction, leptin, ob/ob mouse

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-79

Fermentation metabolites of 14C-labelled aromatic amino acid, tyrosine, detected in the brain in a pig model

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Background and objective: Mood disorders (depression and anxiety) are debilitating and represent a major public health concern. There is growing understanding that diet and gut microbiota influence brain function. Processed foods undergo processing techniques that can cause proteins to become resistant to normal digestion. Enzymatic resistance and transport of resistant protein to the colon promotes its fermentation by gut microbes and may produce neuroactive metabolites that can access the brain and alter mood. This study examined biodistribution of metabolites of the aromatic amino acid and neurotransmitter precursor, tyrosine, following colonic microbial fermentation. The tyrosine was delivered to the colon as a model of tyrosine released from dietary resistant protein by the fermentative hydrolytic processes of a resistant protein-primed microbiota.

Methods: A proven model of human digestion and metabolism, weanling pigs were fed a high resistant protein diet for four weeks to prime their gut microbiota towards protein fermentation. One pig was administered radiolabelled tyrosine in two acid-resistant capsules (each containing 0.1 mg [14C(U)]-L-tyrosine, with 10 MBq radioactivity, 84 mg citric acid, 50 mg methocel), to deliver the tyrosine to the colon. Three pigs were administered similar capsules with unlabelled tyrosine. Blood, urine, faeces, intestinal contents and organ samples were collected three days after capsule administration. Biodistribution of tyrosine metabolites across tissues was measured by liquid scintillation counting. Analyses of metabolites present in non-radiolabelled samples are not reported here.

Results: Approximately 49% of the radioactivity was excreted in urine and faeces. Of the original dose, 7% was recovered in the organs (stomach, small intestine, colon, liver, pancreas, kidney, spleen, heart, lungs and brain). The highest quantity of radioactivity was detected in the small intestine (3.1%) and liver (2.2%), and highest concentration in the liver (0.008 % dose/g) and pancreas (0.007 % dose/g). Radioactivity of 0.008 % dose/g was detected in the colon digesta. 0.14% of the radioactivity was detected in the brain, with the greatest concentration detected in the cerebellum (0.003 % dose/g).

Conclusion: In a pig model, metabolites of tyrosine, fermented by a resistant protein-primed gut microbiota, are able to enter the brain where they could potentially have neuroactive effects.

Keywords: resistant protein, tyrosine, biodistribution, radiolabel, gut microbiota

Conflicts of interests: none

PAB(T1)-80

Effects of protein deficiency and sex-dependent variations on VLDL receptor expression

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Background and objectives: We have previously demonstrated that the expression levels of the liver VLDL receptor (VLDLR) increases during protein deficiency. In this study, using Vldlr knockout mice, we investigated the relationship between increased Vldlr gene expression and the physiological function of VLDLR in hepatic lipid accumulation during protein deficiency. In this experiment, the hepatic Vldlr gene expression varied with sex. Thus, we also analyzed sex-dependent variations in Vldlr expression in male and female gonad-depleted rats.

Methods: The association between increased hepatic Vldlr expression and liver fat accumulation due to protein deficiency was investigated using four-week-old male and female Vldlr-knockout mice (KO) and their wild-type littermates (WT). All the mice were fed either a control diet with 20 % protein or a low-protein diet with 2 % protein for 21 days. Sex-dependent variations in liver Vldlr expression were analyzed using male and female Wistar rats that underwent gonad removal surgery. The mRNA and protein expression levels of VLDLR, amount of liver triglyceride (TG), mRNA levels involved in lipid synthesis and degradation, and the mRNA level of Asns, the target gene of the transcription factor ATF4 which controls VLDLR expression, were measured.

Results: In the WT mice, the liver Vldlr mRNA levels increased under protein deficiency in males, but not in females. Increase in liver fat due to protein deficiency was observed in both male and female WT and KO mice, indicating that lipid uptake by VLDLR is not the main cause of hepatic lipid accumulation. Increased gene expression involved in fatty acid synthesis was observed in the protein-deficient groups, indicating its contribution to the increase in liver fat. VLDLR expression was higher in females than that in males; however, this sex-dependent variation was inconsistent with ATF4 activity. Ovariectomy increased VLDLR expression with ATF4 activation, whereas orchiectomy increased VLDLR expression without ATF4 activation.

Conclusion: Hepatic Vldlr expression and TG content increased with protein deficiency. However, increased VLDLR was not the cause of hepatic fat accumulation. Furthermore, testis-derived hormones may be responsible for the sex-dependent variation in Vldlr expression that females are higher than males.

Keywords: VLDL receptor, Liver triglyceride, Protein deficiency, Sex, ATF-4

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-81

Vitamin D deficiency and insufficiency leads to cardiac atrophy in a rat model.

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Background & Objective: Vitamin D receptor and the enzymatic machinery to synthesize the active hormonal form of vitamin D are present in extra-skeletal tissues, heart being one such tissue. Vitamin D deficiency is leads to cardiac hypertrophy both in animals and humans. In the present study, using a rat model we examined if vitamin D deficiency or insufficiency altered proteolytic systems in the heart leading to cardiac atrophy.

Methods: A vitamin D deficient or insufficient rat model was employed for the study. Serum parameters were estimated using standard methods or commercial kits. Electro cardiography was recorded using three lead ECG. Total protein degradation (TPD) was measured by release of tyrosine in the media, while total protein synthesis (TPS) was measured by 14C-tyrosine taken up by atria. Proteasomal enzymes, calpain and cathepsin activities were measured using specific fluorogenic substrates. Gene expression was done by qPCR, and protein expression was assessed by western blotting. Histological analysis was performed on heart sections using H&E and Masson trichrome stains.

Results: The heart weight/tibia length ratio was significantly decreased in the vitamin D deficient [VDD] group compared to the other two groups. Serum levels of 25OHD3 which reflect Vitamin D status were significantly decreased in both the VDD & low vitamin D [LVD] groups compared to the normal vitamin D [NVD] group. The ECG data demonstrated that the heart rate was significantly higher in the VDD group, indicative of 'Arrythmia'. The TPD was increased, while the TPS was decreased in the atria of the VDD rats. Catalytic activities of the 26S proteasome, calpain and cathepsin were elevated in the VDD heart compared to controls. Expression of atrophy markers, proteasome subunit genes and autophagy markers were increased in the heart of the VDD group compared to control group. Histological analysis of the heart showed disarray of fibres and interstitial fibrosis in the VDD group.

Conclusion: Our data reveals that chronic vitamin D deficiency leads to cardiac atrophy.

Keywords: Vitamin D, Heart, Proteasome, Autophagy, ECG

Conflicts of interests: none

PAB(T1)-82

Histidine enhances memory formation and retrieval in mice.

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Background and objectives: Histidine (His), one of the essential amino acids, is metabolized to neurotransmitter histamine, in the brain. Histamine controls arousal, feeding, and cognitive functions via three types of histamine receptors (H1, H2, and H3). Learning and memory consist of multiple processes including encoding, formation of short-term memory (STM) and long-term memory (LTM), retrieval, reconsolidation and extinction. However, the roles of histidine in each memory process still remains unknown. In this study, we elucidate the effects of histidine administration on memory formation and retrieval in mice.

Methods: In social recognition memory task, adult mice(C57BL/6) were exposed to juvenile mice for 1.5 min every 24 hours (day1: training, day2: test). Mice were assessed social recognition memory by measuring and comparing duration of social investigation behaviors during training and test. Mice received systemic injection or oral administration of histidine with or without antagonists for histamine receptors before training or test.

Results: Systemic injection of His 2 or 6 hours rather than 30 min,12, or 24 hours prior to training improved social recognition memory; mice injected His, but not vehicle, showed significant reduction of social investigate time during test compared to training. These observations suggested that His enhances memory formation. Similar memory enhancing effects of His were observed when mice received a low dose or oral administration of His. Interestingly, systemic injection of His before test improved retrieval of social recognition memory. Co-systemic injection of His with H2 or H1 antagonist blocked improvement of memory formation and retrieval by His, respectively.

Conclusion: We showed that His promotes formation and retrieval of social recognition memory. Our observations suggest that His functions as a memory enhancer that improves memory performance.

Keywords: histidine, memory, amino acid, histamine, cognitive function

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-83

Amino acid metabolites enzyme in mouse milk plays an essential role in forming gut microbiota and brain gene expression during infancy.

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Background and objectives: In a mammalian infant, milk components such as amino acids (AAs) are essential for gut microbiota formation. In addition, the brain is dramatically developed during infancy. Thus, it has been considered that there might be a relationship between milk AAs, gut microbiota formation, and brain development. However, there were no useful animal models to clarify this relationship. An amino acid metabolites enzyme, L-amino acid oxidase 1 (LAO1), is secreted in breast milk and catalyzes several AAs. We previously reported that milk LAO1 affects the pup's gut microbiota formation in mice. Here, this study aims to investigate the impact of milk LAO1 on brain gene expression and ascertain the association of the gut microbiota with the brain gene expression using LAO1 KO mice. Methods and

Results: Focusing on the function of LAO1 in the milk of maternal origin, we performed foster mother exchange on the day of birth using the pup's genotype LAO1 KO and mother WT or LAO1 KO. Microarray analysis revealed that myelin-related genes, Plp1 and Mbp, decreased in the pups drinking LAO1 KO milk. Metabolomics analysis identified the difference in several AAs metabolite levels between WT and LAO1 KO milk. To define the importance of gut microbiota differences on the change of the myelin-related genes expression, fecal microbiota transplantation (FMT) was conducted using germ-free (GF) mice. In GF mice inoculated with feces from the pups drinking LAO1 KO milk, Plp1 expression was also decreased. Metagenomics analysis for gut microbiota composition showed still apparent differences after FMT. Moreover, feces and serum from GF mice were analyzed by metabolomics to explore a critical molecule that connected gut microbiota and brain gene expression. In GF mice inoculated with feces from the pups drinking WT milk, several metabolites levels, for example, 3-Hydroxybutyric acid, were commonly increased in feces and serum.

Conclusions: These data indicate that milk LAO1 contributes to the development of the myelin in the hippocampus through gut microbiota control. Further analysis is required to evaluate whether metabolites, including 3-Hydroxybutyric acid, produced by the gut microbiota could influence the brain gene expression during mouse infancy.

Keywords: Gut microbiota, Myelin, Breast milk, Gut-brain axis, Amino acid

Conflicts of interests: none

PAB(T1)-84

Dietary phosphate reduces skeletal muscle mass in mice

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Background and objectives: In recent years, the use of prepared foods and processed foods has increased in Japan. These foods contain large amounts of phosphate compounds. Excessive phosphorus intake has been shown to reduce kidney function, increase parathyroid function, inhibit calcium absorption, however, its effects on skeletal muscle have not been fully elucidated. Therefore, in the present study, we investigated the effects of excessive phosphorus intake on skeletal muscle mass in mice.

Methods: Fourteen five-week-old male C57BL/6J mice were included in the study, of which seven mice were fed a control diet (0.4% phosphate; CP) and the other seven mice were fed a high phosphate diet (1.2% phosphate; HP) for eight weeks. Their body masses were measured before and after the intervention, and the gastrocnemius muscle, soleus muscle, tibia anterior muscle and extensor digitorum longus muscle were measured after the intervention.

Results: The HP group showed lesser weight gain after 8 weeks of administration of the test diet as compared to the CP group. In addition, skeletal muscle measurements after the intervention showed that the gastrocnemius mass (0.29±0.02 vs. 0.32±0.02‚ p=0.03) and tibialis anterior muscle mass (0.10±0.01 vs. 0.12±0.02‚ p<;0.01) were significantly lower in the HP group as compared to those in the CP group.

Conclusions: The present study revealed that long-term excess phosphorus intake significantly suppressed the development of gastrocnemius and tibialis anterior muscle masses. Although we could not clarify the mechanism of skeletal muscle mass loss due to excessive phosphorus intake from this study, it was suggested that the long-term overconsumption of prepared foods and processed foods may lead to skeletal muscle loss.

Keywords: phosphate, skeletal muscle, processed food, food additive

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-85

Absorption and metabolism of glycerophosphocholine and lecithin

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Background and objectives: Choline is an essential nutrient for normal cellular functions such as cell-membrane phospholipid signalings, acetylcholine synthesis, and methyl-group metabolism. Phosphatidylcholine (PC), the main component of lecithin, is an important food factor as a source of choline, whereas alpha-glycerophosphocholine (GPC), a deacylated form of phosphatidylcholine, has been currently expected as a useful choline supplement. On the other hands, choline-containing compounds are reportedly metabolized by the intestinal microflora to trimethylamine (TMA) and subsequently converted to trimethylamine N-oxide (TMAO) in liver, which is associated with the development of various diseases such as cardiovascular disease. In this study, we focused on dietary GPC and tried to elucidate how GPC is absorbed in the digestive tract and metabolized in vivo. Results &

Conclusions: We conducted long-term feeding and oral administration of choline and GPC to show the differences in absorption and metabolism with TMAO production level. Higher TMAO level was observed with in high-dose GPC supplementation than that of choline. In contrast, in the case of low-dose GPC supplementation, TMAO level was similar to those with other choline supplements. Next, we analyzed the absorption of GPC via a transwell system using human colonic epithelial Caco-2 cells. This study showed that GPC supplementation in apical medium increased choline level in both apical and basolateral medium and suggested that GPC is metabolized to choline in Caco-2 cells and in apical medium. GDE5 was previously identified to be an intracellular enzyme that selectively hydrolyzes GPC to choline and to be highly expressed in mouse intestine and Caco-2 cells, suggesting a possible role for GPC metabolism in intestinal epithelial cells. Because intestinal epithelial cells-specific GDE5-deficient mouse (GDE5 KO mouse) was recently generated and, in this study, in order to elucidate the mechanism of GPC absorption and metabolism, we will examine if GDE5 deficiency can affect absorption and metabolism of dietary GPC and further investigate the functional involvement of GDE5 in the metabolism of PC, the main component of lecithin, in the intestinal tract.

Keywords: Glycerophosphocholine, Lecithin, Choline, Trimethylamine N-oxide, Caco-2

Conflicts of interests: none

PAB(T1)-86

Aromatic amine production in human gut bacteria: the role of aromatic amino acid decarboxylase in serotonin production

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Background and objectives: It has been reported recently that gut bacteria can serve as a source of aromatic amines in the colon. The kinetic parameters of aromatic amino acid decarboxylase (AADC), which catalyzes the decarboxylation of aromatic amino acids to produce aromatic amines, have been characterized in some gut bacteria. However, most previous studies on aromatic amine production in gut bacteria focused on non-proteinogenic aromatic amino acids, and limited studies have addressed the production of aromatic amines from proteinogenic amino acids. Furthermore, the physiological activities of aromatic amines in the colon remain unclear. The purpose of this study is to elucidate the mechanism of aromatic amine production by gut bacteria from proteinogenic aromatic amino acids and to clarify the physiological effects of gut bacterial aromatic amines, especially phenylethylamine, on the host.

Methods: Aromatic amine-producing gut bacteria were cultured in a medium containing L-phenylalanine, L-tyrosine, and L-tryptophan (1 mM each), and then the aromatic amines in the culture supernatant were quantified. The aromatic amines in the culture supernatant of Escherichia coli transformants expressing aadc or its homologs from aromatic amine-producing gut bacteria were also quantified to compare their aromatic amine productivities. The correlation between phenylethylamine production and aadc amounts in human feces was analyzed after culturing the human feces with L-phenylalanine. To examine the effect of gut bacterial phenylethylamine on the host, Enterococcus faecalis wild-type, aadc-deleted, and aadc-complemented strains were colonized in mice, and colonic serotonin level was measured.

Results: We identified five aromatic amine-producing gut bacteria, and aromatic amine productivity varied among the gut bacterial species. Aromatic amine production was observed in E. coli heterologously expressing aadc or its homologs. Fecal culture experiments showed a significant positive correlation between the abundances of phenylethylamine and aadc of Ruminococcus gnavus. Colonic serotonin level of mice colonized with En. faecalis aadc-complemented strain was higher than that of mice colonized with wild-type or aadc-deleted strains.

Conclusions: We identified five aromatic amine-producing gut bacteria and showed that aadc is indispensable for aromatic amine production. Mouse experiments showed that gut bacterial AADC and its reaction product phenylethylamine participate in the colonic serotonin production in the host.

Further Collaborators: Yumiko Mori (Kanazawa University) (Japan)Misaki Nara (Ishikawa Prefectural University) (Japan)Yusuke Kotani (Kanazawa University) (Japan)Hiroki

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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Keywords: Gut bacteria, Aromatic amino acid, Aromatic amino acid decarboxylase, Aromatic amine, Peripheral serotonin

Conflicts of interests: none

PAB(T1)-87

Enhancing zinc absorption via a zinc transporter–targeting strategy

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Background and objectives: Zinc is an essential trace element that functions as a structural, catalytic, and signaling component. So, dietary zinc deficiency puts human health at risk. Zinc deficiency is a serious nutritional problem in developing countries, and in recent years, a marginal zinc deficiency has become a nutritional concern in developed countries. The dietary zinc absorption rate is as low as nearly 30%. Therefore, to prevent zinc deficiency, increased efficiency of zinc absorption in the gastrointestinal tract is warranted. ZIP4 and ZNT1 are zinc transporters that function to absorb dietary zinc in the intestinal tract. ZIP4, located on the apical membrane on the luminal side, is an essential component to take dietary zinc ions up into enterocytes, and ZNT1, located on the basolateral membrane, transports the zinc ions to the blood. In this study, we searched for food-derived components increasing ZIP4 or ZNT1 expression, and subsequently increasing zinc absorption.

Methods: We established a system to screen factors promoting ZIP4 and ZNT1 expression using mouse Hepa and human Caco2 cells, and searched for factors that increased their expression. Food extracts from nuts, grains and spices were prepared using various solvents and adding them to the culture medium of cultured Hepa or CaCo2 cells at final concentrations of 0.1–0.5%. After 24 h culture, the expression level of ZIP4 and ZNT1 was detected by western blotting.

Results: We have identified a number of food extracts from nuts and spices that increased ZIP4 or ZNT1 expression levels. Some extracts additionally contributed to the suppression of ZIP4 degradation and then increased the abundance. Furthermore, these extracts increased the cellular zinc level. In-depth analyses of food extracts that increase ZNT1 expression are necessary in future studies.

Conclusions: Our results suggest that a zinc transporter–targeting strategy may be an effective strategy to improve zinc absorption and thereby prevent zinc deficiency.

Keywords: Zinc absorption, Zinc transporter, ZIP4, ZNT1

Conflicts of interests: none

PAB(T1)-88

Effect of elemental diets on intestinal permeability and immunoglobulin production in indomethacin-induced intestinal injury rats.

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Background and objectives: Crohn's disease (CD) is an inflammatory bowel disease of unknown etiology. Immunological dysfunction and increased intestinal permeability are one of important factor of pathogenesis in CD. Administration of indomethacin (Indo) to rats induces intestinal ulcers similar to those seen in CD patients. Elemental diet (ED) is commonly used as a nutritional therapy for CD in Japan. Despite many hypotheses have been proposed to explain the beneficial effects of ED in CD patients, the mechanisms underlying the effects of ED remain unknown. In this study, to clarify the mechanisms of ED on protection of CD, we evaluated the changes in intestinal permeability of food allergens, expression of tight junction protein and immunoglobulin production in Indo-treated rats.

Methods: Male Sprague-Dawley rats were maintained on standard laboratory chow diet (standard chow group) or commercially available elemental diet (ED group) for 2 weeks. To evoke intestinal damage, Indo was injected subcutaneously (9 mg/kg body weight) once daily for two consecutive days. Two days after the first injection, rats were fasted overnight and the suspension of dried egg white (EW; 0.2 g / 100 g body weight) was administered intragastrically. At 60 min after administration, blood samples were obtained and ovalbumin (OVA) concentrations in plasma were determined by ELISA. Expression of TJ proteins in intestinal mucosa were assessed by quantitative real time PCR. Lymphocytes, isolated from mesenteric lymph nodes (MLN) and spleens, were cultured and concentrations of immunoglobulins in the cultured media were analyzed by ELISA. Result: In standard chow group, the administration of Indo induced mucosal lesions and increased in the intestinal permeability of OVA. Expression of claudin-2 increased and that of claudin-4 reduced. Furthermore, the production of IgA and IgG by MLN and spleen lymphocytes in Indo-treated rats were higher than those in non-treated rats. In contrast to standard chow group, none of Indo-induced changes were observed in the rats ED group.

Conclusion: These findings suggest that the mucosal lesion induced by Indo were due to increased mucosal permeability and changes in mucosal tight-junction proteins. ED may contribute to protect intestinal injury by modulating intestinal permeability.

Keywords: Crohn's disease, elemental diet, intestinal permeability

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-89

LPGAT1/LPLAT7-mediated regulation of acyl chain profiles in muscle phospholipids affects endurance capacity in mice

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Background and objectives: Skeletal muscle consists of both fast- and slow-twitch fibers. Phospholipids are essential structural components of cellular membranes; and the diversity of their fatty acid compositions affects membrane fluidity and permeability. Although some studies have shown that acyl chain species in phospholipids differ among various muscle fiber types, the mechanisms and physiological roles underlying these differences are unclear. Therefore, in this study, we analyzed the phospholipid profiles, and the mechanism and physiological role of regulating the muscle fiber type-specific acyl chain profiles of phospholipids.

Methods: The differences in the acyl chain profiles of phospholipids, such as phosphatidylcholine (PC) and phosphatidylethanolamine (PE), in the murine extensor digitorum longus (EDL; fast-twitch) and soleus (slow-twitch) muscles were analyzed using liquid chromatography-mass spectrometry (LC/MS) and imaging MS. In order to reveal the mechanisms and physiological roles of controlling fatty acid species binding to PC and PE, PC and PE molecular species and endurance capacity were analyzed in genetically modified mice models.

Results: In the EDL muscle, the vast majority (93.6%) of PC molecules contained palmitate (16:0-PC), while in the soleus muscle, in addition to 16:0-PC, 27.9% of PC molecules contained stearate (18:0-PC). Most of the palmitate and stearate were bound at the sn-1 position of 16:0- and 18:0-PC, respectively, and 18:0-PC was found in type I and IIa fibers. The amount of 18:0-PE was also higher in the soleus than in the EDL muscle. Peroxisome proliferator-activated receptor γ coactivator-1α (PGC-1α) induces changes in the muscles' PC profile. Lysophosphatidylglycerol acyltransferase 1 (LPGAT1) was highly expressed in the soleus compared to the EDL muscle, and was upregulated by PGC-1α. LPGAT1 knockout decreased the amount of 18:0-PC and 18:0-PE in murine skeletal muscle, which explains the LPGAT1-mediated regulation of myofiber type-specific acyl chain profiles of PC and PE. Moreover, loss of muscular LPGAT1 expression affected endurance capacity.

Conclusions: In this study, we clarified some of the control mechanisms of myofiber type-specific acyl chain profiles of phospholipids and showed that regulating the acyl chain profiles of phospholipids by LPGAT1 in skeletal muscle had physiological significance in skeletal muscle function. [Further Collaborators] Shuhei Umebayashi, Nanami Senoo, Takumi Akahori, Hiyori Ichida, Takuya Yoshida, Takashi Baba, Yuki Maemoto

Keywords: Glycerophospholipids, muscle, slow-twitch, fast-twitch, acyltransferase

Conflicts of interests: none

PAB(T1)-90

Regulatory expression of interleukin-6 in brown adipocytes

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Background and objectives: There are three kinds of adipocytes, white, brown and beige. White adipocytes accumulate excess energy as fat, whereas brown/beige adipocytes expediate energy as heat. In addition to the role as a regulator of energy balance, white adipocytes secrete various bioactive molecules named as adipokines. In contrast to white adipocyte-derived adipokines, less information is available on adipokines from brown/beige adipocytes. The present study explored adipokine production in cultured brown adipocytes.

Methods: HB2 brown preadipocytes, RAW264.7 macrophages, and C2C12 myoblasts were used. HB2 cells were differentiated into brown adipocytes by culture in the presence of insulin, and C2C12 myotubes were induced by culture under the reduced serum. During differentiation of brown preadipocytes and myoblasts, cells were treated with forskolin (an activator of protein kinase A (PKA) pathway), lipopolysaccharide (LPS, an inducer of interleukin (IL)-6 in macrophages), ascorbic acid 2-phosphate (AsAp, a vitamin C), and U0126 (an MEK1/2 inhibitor). Macrophages were treated with forskolin and LPS one day after cell plating. Adipokine expression was evaluated by RT-qPCR analysis.

Results: Short-term treatment with forskolin induced expression of IL-6 in HB2 brown adipocytes. AsAp treatment during the differentiation also increased IL-6 expression. U0126 inhibited AsAp-induced but not forskolin-induced IL-6 expression. IL-6 has proinflammatory effects as well as anti-inflammatory effects depending on cell context. Forskolin did not affect expression of tumor necrosis factor-α and IL-1β, proinflammatory cytokines, whereas it increased mRNA levels of an anti-inflammatory cytokine fibroblast growth factor 21 in brown adipocytes. LPS expectedly increased IL-6 expression in RAW264.7 macrophages, but forskolin did not affect IL-6 expression irrespective of presence of LPS. IL-6 is also known as a myokine that is secreted from muscular cells. Forskolin but not AsAp increased IL-6 expression in C2C12 myotubes.

Conclusions: 1. Activation of the PKA pathway induces some anti-inflammatory cytokines in brown adipocytes. 2. Mechanism underlying PKA-induced IL-6 expression is different from IL-6 induction by vitamin C, in which extracellular signal-regulated kinase pathway is involved. 3. Role of PKA and vitamin C in IL-6 induction is cell type-dependent. Thus, the present study uncovers regulatory expression of IL-6 as an adipokine in brown adipocytes.

Keywords: interleukin-6, brown adipocyte, macrophage, muscular cell.

Conflicts of interests: none

PAB(T1)-91

Growth retardation induced by protein and indispensable amino acid deficiencies cannot be catch up by a supplementation in growing rats.

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Background & Objectives: In developing countries, children are exposed to a growth retardation risk due to their low protein (LP) intake or poor quality of protein sources. However, the specificity of each indispensable amino acid (IAA) and the ability of children to catch-up their growth retardation remains unclear. The aim of this study was to assess the supplementation efficiency following a protein or IAA (lysine, threonine, and methionine) deficiencies in growing rats, and to identify the specific IAA deficiency effect.

Methods: Sixty growing rats were fed by a control (20% of proteins; P20), a LP (5% of proteins; LP) or IAA deficient (25% of the rat's requirement in lysine, threonine, or methionine; L25, T25 and M25) diets for 3w. Thereafter, all rats were supplemented by the control (P20) or a control-equivalent diet containing free AA. Body weight (BW) and food intake were daily recorded. Naso-anal length (NAL), bone mineral density (BMD) and body composition were measured at the end of each period.

Results: During the deficiency, IAA as LP diets reduced BW gain from day 2 for LP, L25 and M25 and from day 1 for T25. The BW was reduced by 30% for L25 and M25, 50% for LP and 60% for T25. The NAL was also reduced by 9, 18, 25% for L25 /M25, LP and T25. At the end of the deficiency, all groups had less lean body mass (LBM), whereas only LP and T25 had a decreased BMD. During the supplementation, growth resumes and the weight's gap between each group was reduced, but remains after supplementation. The BW were reduced by 15, 25 and 35% for L25/M25, LP and T25, respectively. For NAL and LBM, the gap slightly reduced too, but the difference remains after the supplementation. Indeed, the NAL was reduced by 5% for L25 and M25, 8% for LP and 10% for T25. All groups had reduced kidney, muscle and carcass weight, and LP and T25 had a reduced liver weight and BMD.

Conclusions: A single IAA deficiency as LP induced growth retardation, and the LBM is highly affected. A supplementation allows growth resume, but the growth retardation cannot be catch up.

Keywords: Indispensable Amino Acid Deficiency, Protein Deficiency, Protein Quality, Growth Retardation, Catch Up Growth

Conflicts of interests: none

PAB(T1)-92

The association of adipose triglyceride lipase and hormone-sensitive lipase gene expression in subcutaneous and visceral adipose tissue with habitual dietary carbohydrate intake

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Background and objectives: Little is known about how habitual dietary carbohydrate quality and quantity regulate adipose tissue lipolysis and whether such regulation is altered by body weight status. Hormone-sensitive lipase (HSL) and adipose triglyceride lipase (ATGL) play important roles in the mobilization of stored lipid in adipose tissue and have been implicated in various metabolic disorders. Thus, this study aimed to determine if carbohydrate quality and quantity were linked to ATGL and HSL gene expression in subcutaneous (SAT) and visceral fat (VAT) in adults.

Methods: This is a cross-sectional study that recruited 179 patients aged 19-75 years who were candidates for elective abdominal surgery. During the surgery, SAT and VAT were collected to measure ATGL and HSL mRNA expression via Real-Time PCR. Food intake was assessed using a reliable and validated semi-quantitative FFQ to estimate the habitual dietary intake of total carbohydrate, glycemic index (GI), and glycemic load (GL) as measures of carbohydrate quality. The residual method was used for all dietary exposures to control for the effect of energy intake. Multivariable regression models were used to estimate standardized (STZ) β showing the associations of ATGL and HSL with carbohydrates after adjusting for body mass index (BMI), sex, age, total energy intake, and HOMA-IR.

Results: In VAT, ATGL mRNA showed a negative association for total carbohydrate intake (STZβ=-0.655, P<;0.001) and GI (STZβ=-0.417, P<;0.001). However, in SAT, ATGL associated inversely only with total carbohydrate intake (STZ=-0.302, P=0.02). Gene expression of HSL in VAT was strongly negatively associated with GI (STZβ=-0.769, P<;0.001). Marginally significant interactions with BMI categories were found. Stratified analyses across the BMI groups (non-obese (29.9 <;BMI<;30) and obese (BMI>;31 kg/m2)) revealed substantially different patterns. In the obese group, the associations were stronger for ATGL and HSL gene expression, meaning the expression of these two lipolytic enzyme genes depended on BMI status. There was no significant association of GL with ATGL and HSL.

Conclusions: Dietary carbohydrate quantity, rather than quality, is more likely to modulate ATGL and HSL gene expression from VAT and SAT.

Keywords: Carbohydrate intake, Obesity, Lipid metabolism, Nutrigenomics, Adipose tissue

Conflicts of interests: none

PAB(T1)-93

Rottlerin decline lipid accumulation by inhibiting adipogenesis and de novo lipogenesis via LRP6 degradation and mTOR signaling pathway in 3T3-L1 adipocytes

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Background and objectives: Rottlerin is a PKCδ inhibitor, a natural polyphenol compound from Mallotus japonicus. Rottlerin is known as anti-allergic, antioxidant, and anti-cancer. However, the anti-obesity activity of rottlerin has not been demonstrated. We hypothesized that rottlerin decreases adipogenesis and de novo lipogenesis via LRP6 and mTOR signaling pathways.

Methods: 3T3-L1 preadipocytes were treated with rottlerin at each concentration for 24 h. 3T3-L1 cells were cultured in 6-well-plates with a differentiation medium and treated with rottlerin at each concentration to confirm the lipid accumulation phenotype by Oil Red O staining. Also, our study measured the anti-obesity activity of rottlerin through RT-PCR and western blot.

Results: As a result, cell cytotoxicity was confirmed to be stabilized at 4 µM of rottlerin by LDH assay. At a concentration of 8 µM, the cytotoxicity was about 10% (p<;0.05). Lipid accumulation is reduced in a dose-dependent manner (p<;0.001). C/EBPα and PPARγ, representative adipogenesis markers, were decreased by rottlerin in mRNA expression and protein levels (p<;0.05). The mRNA expression and protein levels of SREBP1, FAS, and SCD1, representative de novo lipogenesis markers, were significantly reduced by rottlerin (p<;0.001). Furthermore, rottlerin induced total LRP6 degradation (p<;0.001) and diminished phosphorylation of mTOR, AKT, S6K, and S6 (p<;0.05).

Conclusions: These results suggest that rottlerin regulates adipogenesis and de novo lipogenesis via LRP6 degradation and mTOR signaling in adipocytes. Taken together, rottlerin is a potential nutraceutical compound that supports treating obesity and fatty liver.

Keywords: Rottlerin, anti-obesity, adipogenesis, de novo lipogenesis, 3T3-L1 adipocytes

Conflicts of interests: none

PAB(T1)-94

Generation and characterization of chemosensory cells from digestive tract-derived primate organoids

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Background and objectives: It is evident that consuming food contributes and provides energy to us. However, at the same time we are facing a risk of intaking unwanted compounds that come along with the food we consume. As there isn't an appropriate in vitro cell model available that allows us to study both nutrition and hazardous chemicals on primate cells, we aimed to generate organoid cell cultures from taste tissues, intestines and pancreatic ducts.

Methods: To generate in vitro cultures, we introduced organoid culture methods to selectively maintain stem cells in the tongue, small intestine and pancreas. Organoids were generated by embedding stem cells in the Matrigel followed by Wnt3a, R-Spondin, Noggin, IGF-1 and FGF-2 supplementation in DMEM/F12 medium. Attempts were made to induce cell differentiation of the organoids we generated by changing cell culture condition. After cell differentiation, chemosensory functions were investigated using these organoids.

Results: We succeeded in generating organoid cultures from three different tissues. By RNA-Seq analysis and immunostaining, each organoid culture represented characteristic of their origin. We further confirmed that cells in the organoid could be induced to become mature cells that express chemosensory machinery such as taste receptors and their downstream molecules. Differentiated organoid were able to respond to nutrients and bitter compounds indicating that there are at least two different chemosensory cells existing within the gustatory tissue we investigated.

Conclusions: By generating primate organoids from taste tissues, the small intestine and pancreas, we are now able to utilize these cells to study the mechanisms of how these cells respond to nutrients or noxious compounds. We concluded that this newly developed organoid culture system is a suitable system to analyze the chemosensory function(s) of the gut in vitro.

Keywords: organoid, taste, intestine, pancreas, chemosensory

Conflicts of interests: none

PAB(T1)-95

Zinc deficient diet feeding induce drastic and irreversible olfactory disorder in mice.

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Background and Objectives: Previous studies indicated that Zinc (Zn) deficiency-induced taste disorder, but the consequence to the olfactory function remains elusive. Here we show that the administration of Zn-deficiency diet feeding induces acute and critical olfactory deficits detected in the odor training mice. To assess the physiological effects of zinc deficiency diet feeding, serum zinc level and mRNA expression of zinc transporters in the brain and small intestine were quantified.

Method: The experimental plan for the present study was approved by the Animal Research-Animal Care Committee of Nihon University. Using a Y-maze system, 8th weeks old C57BL/6J mice were trained to odor sensor mice to distinguish between 1000~1ppm citronellal 2.5% ethanol solution and solvent odor with a drop of water as a reward. After successful training, generalization trials were then instituted to test novel odor samples without reward and thus ensure that the trained mice learned to distinguish the essential distinction (citronellal vs solvent) rather than learned to distinguish the individual samples used during training. After successful training and testing to discriminate between 1 ppm of citronellal solution and solvent, trained mice fed was assigned to 1 of 3 experimental diets as follows, zinc-deficient (Def; 2.2 ppm Zn), low-zinc (Low; 4.1 ppm Zn) and Zinc sufficient (Suf; 33.7 ppm Zn) diets. After that, the Y-maze trials were continuously instituted at an average frequency every other day. Blood sampling was conducted from the tail vein on the 2-4th day and the 8-9th day from the dietary change.

Result and Conclusion: Def diet feeding immediately decreased the percentage correct of Y-maze training score and thus could scarcely conduct generalization trials. Low diet feeding also progressively lowered the score of trained mice over time. A generalization trial did not distinguish the citronellal odor. Even though Def and Low diets change to commercial diets (>;50ppm Zn), these odor disorders remained critical. On the other hand, the Suf diet did not alter the olfactory function of trained mice. Administration of the Def and Low diet significantly attenuated the olfactory functions of the learned mice over time and in a dose-dependent manner.

Keywords: Zinc, Olfactory function, mouse

Conflicts of interests: none

PAB(T1)-96

High-intensity exercise training induces oxidative modification of mitochondrial proteins in skeletal muscle

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Background and objectives: Generation of reactive oxygen species (ROS) is increased in skeletal muscle during exercise. In muscle cells, mitochondria is a major source of ROS, with elevated oxygen consumption. Oxidative stress induces oxidation of cell components, leading to impaired metabolic system. However, the effect of oxidative stress induced by high-intensity exercise training on energy metabolism in mitochondria has not yet been elucidated. The activity of proteins can be regulated by various oxidative post-translational modifications. Therefore, we hypothesized that high-intensity exercise training may cause oxidative modification of metabolism-related proteins. The purpose of this study was to examine the oxidative modification of mitochondrial proteins in an exercise mouse model.

Methods: ICR mice (10 weeks old) were divided into two groups, consisting of sedentary control and exercise groups. In the exercise group, mice performed treadmill running 5 times per week for 2 weeks. On the next day of the final exercise, gastrocnemius muscles were collected. The level of proteins modified by N-hexanoyl lysine (HEL), 4-hydroxy-2-nonenal (HNE), 3-nitrotyrosine and dihalogenated tyrosine was measured in the muscle. Thereafter, HEL- and HNE-modifications of aconitase 2 (ACO2), carnitine palmitoyltransferase 1 (CPT1), dynamin-related protein 1 (DRP1) and malate dehydrogenase 2 (MDH2) were examined.

Results: Oxidative modifications of proteins extracted from muscle tissues were not significantly different between control and exercise groups. HEL- and HNE-modifications of mitochondrial proteins showed a tendency of higher in the exercise group than the control group. Moreover, HEL- and HNE-modifications of MDH2 were significantly higher in the exercise group. In contrast, HEL- and HNE-modified ACO2, CPT1 and DRP1 were not significantly different between control and exercise groups.

Conclusions: Oxidative stress induced by high-intensity exercise training post-translationally modified MDH2 in skeletal muscle, which may cause impaired metabolic system.

Keywords: high-intensity exercise training, reactive oxygen species, N-hexanoyl lysine, 4-hydroxy-2-nonenal, mitochondria

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-97

Establishment of diet-induced zebrafish obesity model for the metabolic studies

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Background and Objectives: Obesity is a global threat to the health of individuals that is characterized by the excessive accumulation of triglycerides in adipose tissues, including in visceral and subcutaneous adipose tissues. Obesity is an independent risk factor for the promotion of arteriosclerosis followed by the onset of thrombotic diseases, such as myocardial infarction. Zebrafish (Danio rerio) are a common research model in fish studies of toxicology, developmental biology, and molecular genetics; it has also been proposed as a promising model organism for nutrition and growth studies in fish. Zebrafish have advantages as a model organism that include their small size, short generation time interval, their capacity to produce numerous offspring, breed easily and very amenable to manipulation in a laboratory tank. Based on these given advantages, this study was aimed to establish suitable model for the study of obesity and metabolic disorders using zebrafish.

Method: Original automated feeding machine for the powdered diet was designed and used for the feeding in this study. Male healthy adult zebrafish were assigned to diet-induced obesity (DIO) group and control group (5 fish/2 L tank) and kept in the water tanks maintained at 28.5oC under a controlled 14-h:10-h light/dark cycle. The commercially available fish diet (Gemma micro ZF300, SKRETTING) was fed 6 times (20 mg x 6/fish/day) during light-period for the DIO group and once a day (20 mg/fish/day) for 4 weeks. Body weight and length were measured once a week with/without anesthesia. Plasma triacylglycerol and cholesterol concentrations were measured by using Determiner reagentsTM.

Results: The body weight and length were significantly increased in DIO group in comparison with the control group. The anesthesia (low-temperature (12oC)-anesthesia or tricaine) during the body size measurement did not show significant effects on the parameters. Plasma triacylglycerol and cholesterol concentrations were not significantly different in the DIO group compared with control group at 4 weeks after the feeding.

Conclusion: The zebrafish which have high genetic similarity to humans are widely used as a model organism for vertebrate. The DIO zebrafish model established in this study may contribute the obesity research.

Keywords: obesity, Zebrafish

Conflicts of interests: none

PAB(T1)-98

Generation of induced pluripotent stem cell-derived beta cells in blood amino acids-like medium

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Background and objectives: Classic cell culture media do not accurately represent the availability of the nutrients in plasma. They usually contain a super-physiological concentration of nutrients such as glucose, amino acids, etc. These high nutrients can alter the metabolism of cultured cells and induce metabolic phenotypes that don't reflect in vivo conditions. Refinement of media formulations has a potential application in maturity modulation of stem cell-derived β cells (SC-β) generation in vitro. This has the potential importance in regenerative medicine for curative diabetes treatment. Previous reports from mice studies have shown that amino acid levels progressively decreased between embryonic day 19 and postnatal day 9. Moreover, elevated amino acid levels have been linked to the activated mammalian target of rapamycin complex 1 (mTORC1) pathway, an increase in islet cell proliferation, accompanied by a low level of maturation. It has been demonstrated that late-stage culture in low levels of amino acids promoted the maturation of SC-β and improved their glucose-stimulated insulin secretion (GSIS) function. To the best of our knowledge, the effect of the physiological level of amino acids on the whole differentiation process has not been investigated. In this study, we asked whether SC-β cells could be derived in media that better recapitulates the composition of human plasma amino acids. And whether it would promote differentiation.

Methods: We established a culture system to derive SC-β cells using a blood-like amino acids medium (BALM). We used a human pluripotent stem cell (hiPSC) line, RPChiPS771-3G, for differentiation and performed real-time PCR, immunohistochemistry, western blot analysis, and GSIS to evaluate differentiation efficiency and maturation level.

Results: We demonstrated that supraphysiological nutrients interfere with endodermal differentiation through upregulation of the mTOR pathway. Moreover, hPSCs can be efficiently differentiated into definitive endoderm, pancreatic progenitors, endocrine progenitors, and SC-β using BALM. The differentiated cells secreted C-peptide in vitro in response to various insulin secretagogues and high glucose levels and expressed several pancreatic β-cell markers

Conclusions: The physiological level of amino acids is sufficient for the derivation of functional SC-β cells.

Keywords: Stem cell-derived β cells (SC-β), diabetes, culture media, amino acids

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-99

Effects of extracellular and intracellular advanced glycation end products in an intrauterine hyperglycemic environment on fetal skeletal muscle

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Background and objectives: In gestational diabetes mellitus (GDM), maternal hyperglycemia exposes the uterus to a hyperglycemic environment through the placenta. As a result, excessive protein glycation in a hyperglycemic environment produces advanced glycation end products (AGEs). AGEs is separated into extracellular AGEs taken up into the cell through receptors and intracellular AGEs generated in the cell. In this study, we examined the effects of two types of AGEs produced in the intrauterine hyperglycemic environment on skeletal muscle using mouse skeletal myoblasts (C2C12) and skeletal muscle in infants of GDM rats (IDM rats) and infants of control mother rats (ICM rats).

Methods: For the effect of extracellular AGEs, C2C12 cells were treated with glucose-induced AGEs (AGE-1) or glyceraldehyde-induced AGEs (AGE-2) at 1.2 mg/mL for 48 hours to examine skeletal muscle cell viability and reactive oxygen species (ROS) generation. Furthermore, the effects of intracellular AGEs were examined by Western blotting of AGEs formation and Akt and AMPK phosphorylation in skeletal muscle from IDM and ICM rats.

Results: In C2C12 cells, AGE-1 and AGE-2 decreased skeletal muscle cell viability by 17 % and 24 % of control, and increased ROS generation by 166 % and 174 % of control. This indicates that AGE-2 is more cytotoxic than AGE-1 in myoblasts. Additionally, in skeletal muscle in IDM rats and ICM rats, phosphorylation of Akt and AMPK was 0.3 times and 0.5 times lower in IDM rats than that in ICM rats. Moreover, AGE-1 and AGE-2 production was 1.6- and 2.8-fold higher in ICM rats than in IDM rats.

Conclusions: We have shown that extracellular AGEs decreased skeletal muscle cell viability and caused ROS generation. Contrary to expectations, however, skeletal muscle from IDM rats exposed to intrauterine hyperglycemia showed decreased intracellular AGEs production, although Akt and AMPK phosphorylation was abrogated. It was suggested that in the intrauterine hyperglycemic environment, insulin resistance inhibits glucose uptake into skeletal muscle cells, resulting in reduced levels of intracellular AGEs production. We would like to further examine the effects of AGEs production in an intrauterine hyperglycemic environment on skeletal muscle differentiation by analysing cellular signaling and myogenic gene expression.

Keywords: intrauterine hyperglycemic environment, advanced glycation end products, skeletal muscle, reactive oxygen species, phosphorylation

Conflicts of interests: none

PAB(T1)-100

Influence of excess intake of asparagine, methionine, tyrosine and valine on plasma concentrations of amino acid-amadori products in chickens

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Background and objectives: Glycation is a non-enzymatic chemical reaction in which carbonyl groups of reducing sugars form Schiff bases with amino groups of proteins and amino acids. The Schiff base undergoes Amadori rearrangement to form Amadori products (APs). Chickens are hyperglycemic animals, and seven amino acid-APs (Ile/LeuAP, LysAP, PheAP, TrpAP, TyrAP, and ValAP) have been detected in chicken plasma. It was also found that the plasma concentration of amino acid-APs correlated to the plasma concentration of amino acids other than the substrate amino acids. Furthermore, even under in vitro conditions, the concentration of specific amino acid-APs correlated to the concentrations of non-substrate amino acids. These results suggests that amino acids other than the substrate may function as catalysts for the generation of amino acid-APs in vivo. In this study, therefore, Asn, Met, Tyr, and Val, which promoted the formation of amino acid-APs under in vitro conditions, were excessively fed to chickens to examine their influences on plasma amino acid-APs concentrations.

Methods: Animals - 10-day-old single comb White Leghorn male chickens were fed diets with 2 % excess of Asn, Met, Tyr and Val, respectively, or a control diet for 3 days. Samples - Blood was collected from the heart under isoflurane anesthesia, and the blood was centrifuged at 5,000 x g for 20 min at 4 ℃ to separate plasma. Plasma samples were defatted and deproteinized, and LC/MS was used to determine plasma Asn and GluAP concentrations in the Asn excess group, plasma Met and TrpAP concentrations in the Met excess group, plasma Tyr and Ile/LeuAP concentrations in the Tyr excess group, plasma Val and PheAP concentrations in the Val excess group were measured.

Results: Excess Val intake significantly increased plasma PheAP concentration, while excess Asn, Met, and Tyr intake did not significantly affect plasma GluAP, TrpAP, and Ile/LeuAP concentrations compared to controls. Plasma GluAP, TrpAP and Ile/LeuAP concentrations showed a significant positive correlation to substrate amino acid concentrations, and plasma PheAP concentration showed a significant positive correlation to plasma Val concentration.

Conclusion: It is suggested that Val may catalyze the formation of PheAP in vivo.

Keywords: Glycation, Amino acid, Amadori products, chicken

Conflicts of interests: none

PAB(T1)-101

Cystine supplementation sustains plasma mercaptalbumin levels in rats fed low-protein diets more effectively than methionine

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Background and objectives: In recent years, a relationship between the oxidized/reduced state of plasma albumin and inflammation has been suggested. We recently reported that dietary cystine maintained plasma mercaptalbumin levels in rats fed low-protein diets. Cystine is the oxidized dimer of cysteine, which can be synthesized from methionine. The present study aimed to compare the influence of cystine and methionine on plasma mercaptalbumin levels and the gene expression of inflammation-related molecules in blood cells of rats fed low-protein diets.

Method: Male Sprague-Dawley rats were fed a 20% soy protein isolate diet (control group), 5% soy protein isolate diet (low-protein group) or 5% soy protein isolate diet supplemented with either methionine (low-protein+Met group) or cystine (low-protein+Cyss group) for 1 week. The percentage of mercaptalbumin within total plasma albumin was analyzed by high performance liquid chromatography. The gene expression of inflammation-related molecules in blood cells were analyzed by real-time PCR.

Results: The percentage of mercaptalbumin within total plasma albumin in both the low-protein+Met and low-protein+Cyss groups was significantly higher than in the low-protein group. However, the percentage of mercaptalbumin within total plasma albumin in the low-protein+Met group was significantly lower than in both the control and low-protein+Cyss groups. Treatment with buthionine-(S,R)-sulfoximine, an inhibitor of glutathione synthesis, did not influence the percentage of mercaptalbumin within total plasma albumin in rats fed the low-protein diet supplemented with cystine. Supplementation with cystine and methionine represses the increase in the mRNA levels of tumor necrosis factor-α, interleukin-6, interleukin-1β and cyclooxygenase 2 in the blood cells of rats fed low-protein diets. On the other hand, no significant differences in the levels of these mRNA were observed between the low-protein+Met and low-protein+Cyss groups.

Conclusions: Supplementation with cystine may be more effective than that with methionine to maintain plasma mercaptalbumin levels in rats with protein malnutrition. Cystine might regulate plasma mercaptalbumin levels via the glutathione-independent pathway.

Keywords: mercaptalbumin, cystine, methionine, low-protein diet, rat

Conflicts of interests: none

PAB(T1)-102

The combination of Pediococcus acidilactici CECT9879 (pA1c), chromium picolinate and oat beta-glucans has blood sugar-regulating effect and alleviates metabolic syndrome-related comorbidities in mice

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Background and objectives: Different probiotics and bioactive compounds have emerged as a natural alternative to the classic treatments of metabolic syndrome-related diseases such as obesity, insulin resistance and diabetes. Previous data from our group suggest that Pediococcus acidilactici CECT9879 (pA1c) could be effective in regulating blood glucose. Hence, the objectives of this study were to verify the effectiveness of pA1c on glycemic regulation, to compare its effect with other normoglycemic compounds (chromium picolinate (PC) and oat beta-glucans (BGC)) and to evaluate the possible synergistic effects of the combination of pA1c with these bioactive compounds on the regulation of glucose and lipid metabolism in diet-induced obese mice.

Methods: To induce diabetes and obesity, 4-week-old male C57BL/6J mice were fed a high fat/high sucrose diet (HFS) for 6 weeks. Animals were then divided into eight groups for ten weeks (n=12 animals/group): control diet group, high fat/high sucrose (HFS) group, pA1c, PC, BGC, pA1c+PC+BGC, pA1c+PC, and pA1c+BGC. Fasting blood glucose determination was assayed, and a glucose tolerance test was performed in week nine. Fat depots, liver and other organs were weighed, and different serum biochemical parameters were analyzed. Gene expression analyses were conducted by real-time quantitative-PCR.

Results: All the groups supplemented with the probiotic significantly ameliorated glucose tolerance after an intraperitoneal glucose tolerance test what verifies the blood sugar-regulating effect of pA1c. Further, although no effects were observed on body weight, animals supplemented with pA1c+PC+BGC exhibited lower proportion of visceral adiposity and higher proportion of lean muscle tissue, together with an improvement in the brown adipose tissue in comparison with HFS group.

Conclusions: Our data confirm the effectiveness of pA1c on glycemia regulation and suggest that the combination of pA1c with PC and BGC could be a potential synbiotic for blood sugar regulation and may help to fight diabetes and obesity.

Funding: This research was funded by a grant from Government of Navarra (Ayudas para la contratación de doctorandos y doctorandas “Doctorados industriales 2020”) [Reference: 0011-1408-2020-000010].

Keywords: Probiotics, Diabetes, Obesity, Metabolic Syndrome, Synbiotic

Conflicts of interests: Josune-Ayo is shareholder of the company Genbioma Aplicaciones S.L., Josune-Ayo and María-

Oneca are co-authors of the patent [PCT/EP2020/087284]. The rest of the authors declare no conflict of interest.

PAB(T1)-103

Effect of a high sucrose/high fat diet on blood fat-soluble vitamins levels in diabetes

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Background and objectives: Diet is closely involved in the onset and progress of diabetes mellitus (DM). Oral intake of fat-soluble vitamins, calcium, unsaturated fatty acids, zinc, and iron is reported to prevent the onset and advance of DM. However, the concentration of these nutrients in the body is rarely measured, and the relationship between the progress of DM and their concentration in the body has not been clarified. Therefore, in this study, we focused on fat-soluble vitamins. We investigated the changes in the blood levels of fat-soluble vitamins caused by DM and a high sucrose/high fat (HSF) diet using an SDT fatty rat model of obesity-induced type 2 DM.

Methods: Five male SD rats and SDT fatty rats were randomly divided into two groups. One group was provided a standard experimental diet (CE2) and the other group was provided an HSF diet for 40 weeks. At the end of the experiment, blood parameters (fasting blood glucose, chemistry, and fat-soluble vitamins), pancreatic insulin gene expression, liver fat-soluble vitamin levels, and serum vitamin-binding protein levels were examined.

Results: Serum retinol was significantly higher in SDT fatty rats than in the SD+CE2 rats. There was no significant difference in hepatic retinol and retinol palmitate levels among the four groups. Serum RBP4 levels were significantly higher in the SDT fatty+CE2 than in the other three groups. Serum 25(OH)D3 was significantly lower in SDT fatty rats than in the SD rats; further, it was significantly lower in the SDT fatty+HSF than in the SDT fatty+CE2. However, there was no significant difference in 1α,25(OH)2D3 between the 4 groups. The serum VDBP levels were not significantly different between the 4 groups. The α-tocopherol and MK-4 levels were significantly higher in the SDT fatty+HSF rats than in the other three groups. PK tended to be higher in the SDT fatty+HSF rats than in the other three groups.

Conclusions: Serum fat-soluble vitamin levels fluctuate with DM. Further, HSF load in DM alters the serum 25(OH)D3, α-tocopherol, and vitamin K levels.

Keywords: fat-soluble vitamins, Diabetes mellitus, high sucrose diet, high fat diet

Conflicts of interests: none

PAB(T1)-104

A potential mechanism underlying paternal transmission of diet-induced metabolic stress through angiogenin-mediated tRNA fragmentation

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Background and objectives: Offspring from diet-induced obese mice showed metabolic dysregulation phenotype despite of normal diet feeding. It has been reported that tRNA fragments, increased by metabolic stress in germline, function as a mediator for transgenerational effects. Angiogenin is one of ribonucleases involved in generation of tRNA fragments. Although multiple studies have shown the increase of tRNA fragments due to cellular stress, it is not fully understood how the tRNA fragmentation are induced. We investigated a potential molecular mechanism underlying the upstream of angiogenin-mediated tRNA fragmentation.

Methods: Small RNA sequencing and tRNA methylation analysis were conducted for sperms of control diet (CD)- and high fat diet (HFD)-fed mice. RNA expression of tRNA modifying genes were measured by qRT-PCR using SYBR Green kit and protein expression and activation of AMPK signaling were measured by western blots. For functional validation, Compound C (an AMPK inhibitor, CC)-treated or non-treated NIH/3T3 cells were further analyzed for qRT-PCR, western blots, and mRNA sequencing.

Results: According to the results from sperm smRNA sequencing, 3' fragments from tRNA-Gly, Lys, and Pro were particularly increased in HFD compared to CD, although the overall amounts of tRNA fragments were not changed overall. Among tRNA modifying genes, tRNA methyltransferases, Dnmt2 and Nsun2 were upregulated in testis in response to HFD, but methylation status was not changed. Angiogenin expression was significantly increased and AMPK-mTOR pathway, a potential upstream regulator, was altered in HFD. Changing activity of AMPK-mTOR pathway using CC led to Angiogenin induction in the NIH/3T3 cells, resulting to increase of tRNA fragments including tRNA-Gly.

Conclusions: Our data suggested that alteration of AMPK activity by diet stress might mediate Angiogenin-mediated tRNA fragmentation which is a key mediator of transgenerational mechanism of metabolic dysregulation.

Keywords: Angiogenin, tRNA fragment, AMPK, transgenerational effects, metabolic stress

Conflicts of interests: none

PAB(T1)-105

Kynurenine metabolism is involved in the link between nonalcoholic fatty liver disease (NASH) and chronic kidney disease (CKD)

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Background and objectives: Kynurenine (KYN) pathway (KP) is the principle route of tryptophan metabolism, and many metabolites of the KP, such as KYN and quinolinic acid (QA), have physiological activity in the central nervous system. We have shown that accumulation of QA may be involved in the pathogenesis of chronic kidney disease (CKD). Non-alcoholic steatohepatitis (NASH) is a metabolic disease associated with hepatic fibrogenesis caused by obesity. Recently, the NAD salvage pathway has been reported to be affected in NASH. And, the possible link between NASH and CKD recently has attracted considerable scientific interest. In this study, we aimed to clarify the association of NASH with renal fibrosis that is a complication of CKD, and how the KP affected there.

Methods: Seven-week-old male C57BL/6J mice were fed Gubra Amylin NASH (GAN) diet, a sample containing high fat (40%), high fructose (22%) and high cholesterol (2%) for 26 weeks. Sera from these animals were subjected to biochemical analysis. Liver and kidney were subjected to HE staining and Sirius Red staining, and quantitative PCR was performed for the gene expression levels of fibrosis-related factor (Col1a1 and a-SMA) and KP enzymes.

Results: NASH group was obese with a marked increase in body weight, liver weight and fat weight. In the NASH group, a significant increase in Col1a1 gene expression in the liver and a slight increase in Sirius Red staining positive images were observed, indicating that mild fibrosis of the liver had occurred. Biochemical analysis of serum showed significant increases in total protein, ALT, and other parameters, indicating an inflammatory state. Interestingly, a significant increase in Col1a1 and a-SMA gene expression was observed in the kidneys, and an increase in Sirius Red staining positive image was observed, indicating that renal fibrosis also was accelerated. KYN metabolism-related gene expression in the NASH liver showed decreased, but QPRT gene expression in the kidney of NASH showed increased.

Conclusions: We demonstrated that renal fibrosis is present in the GAN feed-induced NASH model, and that NASH and CKD are coupled. In addition, we suggested that KP, especially QA, may be involved in the link between NASH and CKD.

Keywords: chronic kidney disease, Kynurenine pathway, Non-alcoholic steatohepatitis, NASH, renal fibrosis

Conflicts of interests: none

PAB(T1)-106

Studies on the vitamin E metabolism in Otsuka-Long-Evans-Tokushima-Fatty rats

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Background and objectives: The distribution and transport of vitamin E, a fat-soluble vitamin, are affected by lipid metabolism and lipoprotein metabolism. However, the effects of changes in lipid metabolism in metabolic syndrome on vitamin E metabolism are not fully understood. The purpose of this study is to characterize vitamin E metabolism in the Otsuka-Long-Evans-Tokushima-Fatty (OLETF) rat, which is a metabolic syndrome-model animal spontaneously developing obesity, hyperlipidemia, hypertension and type 2 diabetes mellitus generated with age. In this study, young OLETF rats were used to measure changes in vitamin E metabolism before the onset of metabolic syndrome.

Methods: Male OLETF rats and control LETO rats (5-week-old) were fed an AIN-93 diet containing 50 mg/kg of RRR-α-tocopherol for 2 weeks. The α-tocopherol concentration in plasma and tissues and the urinary excretion of α-CEHC, a metabolite of α-tocopherol, were measured by HPLC.

Results: Food intake and final body weight of OLETF rats were higher than those of LETO rats. α-Tocopherol concentration in the liver was lower in OLETF rats than in LETO rats, while that in the plasma, kidney, and perirenal adipose tissue was not significantly different between OLETF and LETO rats. In addition, urinary excretion of α-CEHC was lower in OLETF rats than in LETO rats.

Conclusions: Thus, the storage of α-tocopherol in the liver was reduced and its catabolism was suppressed in OLETF rats, although the intake of α-tocopherol was higher in OLETF rats than in LETO rats. The data suggest that the bioavailability of vitamin E already decreases even before the onset of metabolic syndrome.

Keywords: metabolic syndrome, OLETF rat, α-tocopherol, vitamin E

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-107

Smek2 is a multi-function regulator of three major nutritions

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Backgrounds and Objectives: Suppressor of mek1, homolog 2 (Smek2) was identified by author's research group as the responsible gene for diet-induced hypercholesterolemia in exogenously hypercholesterolemic (ExHC) rat. Although it is becoming clear that it is the same gene as protein phosphatase 4 regulatory subunit 3B (Ppp4r3b), function of Smek2 is not fully discovered. We investigated the function of Smek2 by analyzing the phenotypes of ExHC rats that have almost lost Smek2 function by a 10-bp deletion mutation.

Methods: For analysis, we established ExHC.BN-Dihc2BN (congenic) strain by backcrossing. Congenic rat has an allele, the region on chromosome 14 containing Smek2, derived from Brown-Norway (BN) rats. Sprague-Dawley (SD) rats, ExHC rats, and congenic rats were fed a high-cholesterol diet for 2 weeks. After feeding period, we measured biochemical parameters and gene expression levels related to the metabolism of the three major nutrients in the liver and blood.

Results: Congenic rats did not develop diet-induced hypercholesterolemia after the high-cholesterol diet. In ExHC rats, the triacylglycerol (TAG) levels were lower in both blood and liver than in SD rats. The mRNA levels of lipogenic genes in the liver of ExHC rats were significantly lower compared with those of SD and Congenic rats. The mRNA expression of phosphofructokinase liver-type (Pfkl), the rate-limiting reaction in glycolysis, was decreased and the substrate of Pfkl, fructose-6-phosphate, was increased in the liver of ExHC rats. These changes were not observed in the liver of congenic rats. Taken together, ExHC rats exhibited glycolytic deficiency caused by Smek2 dysfunction, and the resulting TAG deficiency was the causative background of diet-induced hypercholesterolemia. In addition, ExHC rats showed high blood homocysteine levels and extremely low expression of sarcosine dehydrogenase (Sardh), a gene involved in one-carbon metabolism. It was suggested that Smek2 also affected amino acid metabolism.

Conclusion: Smek2 is a gene that can affect the metabolism of all of the three major nutrients.

Keywords: model animal, gene mutation, metabolic disease, transcriptional regulator

Conflicts of interests: none

PAB(T1)-108

Liver-specific release of SMP30 into serum exosomes is mediated by the activation of CINC-1/STAT3 signaling in ODS rat

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Objective: Osteogenic Disorder (ODS) rat has a hereditary defect in ascorbic acid (AsA) biosynthesis and is a valuable animal model for elucidating the physiological role of AsA. Senescence marker protein 30 (SMP30), which regulates the biosynthesis of AsA in many mammals, except primates and humans, was recently recognized as a kind of enzymes, gluconolactonase. However, the precise relation between SMP30 and AsA-deficient condition is not completely understood in humans. Therefore, this study investigated whether SMP 30 has new physiological functions in ODS rats except for gluconolactonase activity.

Method: The mechanisms by which AsA deficiency provokes inflammatory responses in the liver were investigated in ODS rats. Male ODS rats (4-wk-old) were pair-fed with a diet containing sufficient 0.1 % AsA (an AsA-suf group) or without AsA (an AsA-def group) for 14 days.

Results: On day 14, the hepatic SMP30 expression was significantly lower in the AsA-def group than in the AsA-suf group, whereas renal SMP30 expression did not differ. In contrast, serum, hepatic and renal AsA concentration was significantly decreased in the AsA-def group. In serum exosomes, expressions of SMP30 and hepatic-derived exosome markers (haptoglobin and ASGPR1) in the AsA-def group were significantly increased compared with the AsA-def group. However, renal-derived exosome marker NGAL expression did not change. Previous study showed that CINC-1/STAT3 signaling activates the exosomes released in the liver. Therefore, we determined whether AsA deficiency stimulates CINC-1/STAT3 signaling and provokes proinflammatory responses in the liver. As a result, serum CINC -1 levels, hepatic STAT3 activity, hepatic CXCR2 (CINC-1 receptor), and expressions of STAT3-targete genes (haptoglobin, AGP, SOCS3) were significantly increased in the AsA-def group. Furthermore, the AST/ALT ratio, a liver-specific inflammatory marker, was also elevated in the AsA deficient-condition. These results showed that AsA deficiency induces the liver-specific release of SMP30 into the serum exosomes via the activation of CINC-1/STAT3 signaling, resulting in liver injury.

Conclusion: This study revealed that hepatic-derived exosome SMP30 expression is a potential biomarker of liver injuries in ODS rats. Significantly, this mechanism is mediated by the CINC-1/CXCR2/STAT3 signaling. These results suggest that exosome release of SMP 30 may be an indicator of AsA deficiency.

Keywords: SMP30, Ascorbate deficiency, Exosome, biomarker, inflammation

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-109

Scheduled access to a highly palatable food changes the activity pattern of orexin-containing neurons in the lateral hypothalamus

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Background and objectives: Our preliminary studies suggest that diurnal, intermittent access (2 h) to a highly palatable food (HPF) increased its intake and decreased intake of normal chow (NC; 22 h) in mice, resulting in no change in total caloric intake a day. Dissection of the olfactory nerve abolished the increase of the HPF intake, suggesting that odor of HPF contributes to the gradual increase of HPF intake during the light period of time. To explorer underlying mechanism by which the olfactory cue increased food intake, we focused on the activity of neurons which have feeding-related neuropeptides such as orexin and melanin-concentrating hormone (MCH) in the lateral hypothalamic area, which is called the feeding center.

Methods: We examined whether the odor of the HPF specifically increased c-fos expression, a neuronal activation marker, in orexin- and MCH-containing neurons in the hypothalamus. Two groups (HPF-fed, NC-fed) of mice received intermittent, scheduled access to the HPF or NC for 2 hours during the period of time for 8 days. On day 9 at the time of HPF presentation, half of each group (HPF-fed/HPF-odor, NC-fed/HPF-odor) received only the odor of HPF; the other half (HPF-fed/NC-odor, NC-fed/NC-odor) was exposed to the odor of normal chow. Additionally, we also examined c-fos expression by period of time (ZT1, ZT6.5).

Results: We found that c-fos expression in orexin-containing hypothalamic neurons significantly increased in HPF-fed groups (HPF-fed/HPF-odor, HPF-fed/NC-odor) when each group received HPF or NC odor on test day, respectively. Furthermore, the activity of orexin neurons in ZT1 was more active than in ZT6.5. In addition, at specific coordinates (-1.3 mm from bregma), orexin neurons were more active in HPF-fed groups than in NC-fed groups.

Conclusion: Our present results suggest that scheduled access to HPF alters the activity pattern of orexin-containing hypothalamic neurons during the light period. The diurnal activation of orexin-containing hypothalamic neurons may contribute to increase of HPF intake during the light period in mice.

Keywords: Scheduled access, Highly palatable food, Orexin

Conflicts of interests: none

PAB(T1)-110

Serum Metabolic Profiling of Rat Fed Folate and Vitamin B12 Depleted Diet

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Background and objectives: Folic acid and vitamin B12 are essential nutrients involved in C1-metabolism. These deficiency causes pernicious anemia and they are also important in the normal function of many metabolisms including amino acids and nucleotides. Here we examined the changes of metabolism of rat fed the folate and vitamin B12 depleted diet.

Methods: Rats were fed the folate and vitamin B12 depleted diet (AIN-93G) for 7 and 10 weeks and then sacrificed under anesthesia. Folate and vitamin B12 were measured by the bioassay. Homocysteine was measured with HPLC. Serum was analyzed with a GCMS/MS system to obtain metabolic profiling. Liver was stained with HE.

Results: Rats fed folate and vitamin B12 depleted diet for 7 weeks showed the moderate and for 10 weeks showed severe deficient status judged from the vitamins and homocysteine status. The liver of folate-depleted rat showed lipid accumulation and inflammation and the status was severe in the rat fed folate and vitamin B12 depleted diet. The metabolic profiling using GCMS/MS revealed the metabolite profiles were gradually changed according to term of the feeding. Some organic acid and amino acid including homocysteine levels in the serum from the rats fed the folate depleted was found. The change of the profile caused the depletion of vitamin B12 was small.

Conclusion: Metabolic profile of folate deficiency was proceeded the term of feeding the diet and the effect of vitamin B12 on it was small.

Further collaborators: Naoki Okada, 1)2)

Keywords: Folate, Vitamin B12, Metabolic profiling, GCMS/MS

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-111

Regulation of glucoprivation-induced carbohydrate selection by NPY-CRH neural axis in the paraventricular nucleus of the hypothalamus

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Background and objectives: Feeding is important to maintain energy homeostasis and control macronutrient metabolism in animals. While neural mechanisms responsible for the regulation of total calorie intake have been extensively studied, that of food selection remains elusive. Our lab previously reported that a subset of corticotropin-releasing hormone (CRH) neurons expressing fasting-responsive AMP-activated protein kinase (AMPK) in the paraventricular nucleus of the hypothalamus (PVH) is necessary for a high carbohydrate diet (HCD) selection over a high fat diet (HFD) during refeeding after fasting. Here, we investigated the role of neuropeptide Y (NPY)-CRH neural axis in the PVH in 2-deoxy-D-glucose (2-DG)-induced change in food selection in mice. Two-diet choice experiment revealed that intraperitoneal (IP) injection of 2-DG increased HCD intake while it decreased HFD intake. Intracerebroventricular (ICV) or intra-PVH NPY injection increased HCD intake along with a slow increase in HFD intake. Chemogenetic inhibition of PVH CRH neurons and preferential knockdown of AMPK in PVH CRH neurons suppressed both 2-DG and NPY-induced HCD intake but not HFD intake. Importantly, intra-PVH injection of antagonists for Y1R and Y5R blocked 2-DG-induced HCD intake preferentially. By contrast, PVH injection of melanocortin-4 receptor (MC4R) agonist, Melanotan II (MTII), inhibited HFD intake but not HCD intake after the intra-PVH NPY injection. We found that 2-DG increased the expression of a neural activation marker, c-fos, in PVH-projecting NPY neurons in several brain areas including the nucleus tractus solitarius (NTS). Optogenetic activation of PVH-projecting NPY neurons in the NTS increased c-fos expression in the PVH and increased HCD intake along with a slow increase in HFD intake similar to those observed after ICV or intra-PVH injection of NPY. Collectively, these results suggest that NPY-CRH neural axis in the PVH is necessary for 2-DG-induced HCD selection and HFD selection is mediated by a distinct neural circuit in the PVH.

Keywords: Carbohydrate selection, neuronal circuits
Conflicts of interests: none

PAB(T1)-112

Hydroponics as a route to generate vitamin B12-biofortified plants that allow consumers to meet the Reference Nutrient Intake

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Background and objectives: Vitamin B12 (cobalamin) plays an important role as a cofactor in various metabolic processes, including DNA synthesis and red blood cell maturation. In humans, vitamin B12 can only be synthesised by colonic microorganisms, but because the colon is not a site of B12 absorption, it is not available to the host. Therefore, human vitamin B12 nutrient requirements can only be met through the consumption of vitamin B12-containing foods or supplements, or via injections. Plants do not require vitamin B12 and do not synthesise it, so only animal-derived foods are useful sources of vitamin B12. Accordingly, those following vegetarian and especially vegan diets are at risk of not consuming sufficient B12 to meet their nutritional needs. Supplements can be part of the solution, but if B12 supplements are not taken with food, absorption of vitamin B12 is likely to be limited because secretion of the intrinsic factor depends on the secretion of gastric acid. The overall aim of this research was to investigate the biofortification of food plants with vitamin B12.

Methods: We grew a variety of small leafy green vegetables and herbs from seeds using hydroponic systems and once established added cyanocobalamin to the standard nutrient solution. Samples were collected over time and analysed for cyanocobalamin using an LC-MS/MS method developed in-house.

Results: Cyanocobalamin was detected in all the tested plants grown in 20 µM cyanocobalamin but there were large differences in the concentrations with lettuce having the lowest content (0.03 ± 0.001) and mizuna the highest content (0.52 ± 0.09). Cyanocobalamin contents increased as the concentration in the nutrient solution increased (5-20 µM), and uptake of cyanocobalamin increased with exposure time. Mizuna was fortified with up to 3 µg (g fresh weight)-1 cyanocobalamin. For a mix of plants, 2-4 g of plant tissue was sufficient to achieve the UK reference nutrient intake (1.5 µg/day).

Conclusions: We have demonstrated that plants take up cyanocobalamin via their roots and accumulate it at µg/g fresh weight concentrations, which is sufficient to achieve RNIs. Future research should focus on determining the bioavailability of vitamin B12 from plants. [Conflict of Interest Disclosure] The authors declare no conflict of interest.

Keywords: vitamin B¬12, biofortification, hydroponic, plants
Conflicts of interests: none

PAB(T1)-113

Identification of psychological and brain responses profiles related to eating habits in healthy young women: Towards the use of neurofeedback to prevent eating disorders

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Background and objectives: People with obesity or eating disorders often present anomalies in brain areas involved in hedonic and cognitive control of eating. First, we aimed at exploring the brain responses of normal-weight healthy young women with high or low consumption of Western-type (WT) foods (i.e. sweet, fatty, transformed) to identify individual profiles at risk and brain targets for preventive interventions. Second, we aimed at developing functional near-infrared spectroscopy (fNIRS) neurofeedback to train subjects to increase their prefrontal cortex activity and related inhibitory control.

Methods: Between 2018 and 2021, we performed a questionnaire study in 655 normal-weight female students to investigate cognitive and behavioral components of eating and other life and consumption habits. Fifty volunteers with high or low WT food consumption were subjected to blood oxygen level-dependent functional magnetic resonance imaging (fMRI) during a cognitive food choice task and functional connectivity (FC) during resting-state fMRI. Thirty additional healthy volunteers were subjected to a fNIRS neurofeedback (NF) single session where they were instructed to voluntarily increase the activity of their dorsolateral prefrontal cortex (dlPFC, via real-time visual gauge).

Results: The questionnaire study revealed risky eating habits in healthy female students, such as transient emotional hyperphagia (from 50% in 2018 to 90% in 2021 during COVID). High vs. low consumers of WT foods presented different psychological components of eating, brain responses and FC in the frontostriatal circuit involved in the hedonic and cognitive control of eating. These data and previous papers justified our choice to perform NF on the dlPFC, which is involved in the inhibitory control. Twenty-two participants (73%) of the one-session NF experiment managed to increase their dlPFC activity during their 10 best trials over 15.

Conclusions: Our data showed that high consumption of WT foods is associated with specific psychological traits and brain functions related to food reward and inhibitory control of eating. Training people to regulate their dlPFC activity might favor a better control overeating, and our preliminary results on one-session NF are promising for the next step of our project, which is to implement this strategy with multiple-session NF in young women with emotional hyperphagia.

Further collaborators: Paul Meurice and Brieuc Léger (INRAE, INSERM, Univ Rennes, CHU Rennes, Nutrition Metabolisms and Cancer, NuMeCan, France)

Keywords: Eating behavior, Decision-making, Neuroimaging, Neurofeedback, Eating disorders

Conflicts of interests: none

PAB(T1)-114

The effects of long-term almond consumption on whole-body insulin sensitivity, postprandial glucose responses, and free-living glucose patterns in men and women with prediabetes: A randomized controlled trial

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Background and objectives: Healthy diets rich in nuts as part of lifestyle interventions can prevent the development of prediabetes into type 2 diabetes by improving glucose metabolism. So far findings concerning the effects of almond consumption on glucose metabolism are inconclusive which might relate to body weight gain. We here investigated the effects of long-term almond consumption on glucose metabolism in a free-living setting without detailed dietary instructions in overweight or obese men and women with prediabetes.

Methods: Forty-three participants volunteered in this randomized, cross-over trial with a control and intervention period of 5 months separated by a wash-out period of 2 months. In the intervention period participants consumed 50 g whole almonds per day. At the end of both periods whole-body insulin sensitivity was assessed by a hyperinsulinemic euglycemic clamp, and postprandial glucose responses, and 48h free-living glucose patterns were measured.

Results: Five months almond consumption significantly decreased insulin sensitivity (P=0.002), and increased postprandial glucose concentrations (P=0.019), as well as fasting insulin concentrations (P=0.003) as compared to the control period. The AUC for 24h glucose concentrations just did not reach statistical significance (P=0.066). Almond consumption also significantly increased BMI (P=0.002), and waist circumference (P=0.013), which was supported by the increased energy intake (P=0.031) during the intervention period based on data from the food frequency questionnaires (FFQ). The effects on glucose metabolism could only partly be explained by the observed increase in body weight as the almond effect remained after correcting for BMI changes.

Conclusions: In prediabetic participants, long-term almond consumption showed adverse effects on insulin sensitivity and glucose metabolism. Effects could only partly be explained by changes in BMI and energy intake, suggesting that the almonds did not fully replace other food items. Therefore, it might be necessary to provide more supporting guidelines on how to incorporate energy-dense foods like nuts into healthy diets.

Keywords: almonds, prediabetes, insulin sensitivity, glucose metabolism, hyperinsulinemic euglycemic clamp

Conflicts of interests: none

PAB(T1)-115

A comparison of zinc absorption from zinc biofortified and regular (yellow) potatoes in young Andean women

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Background and objectives: Zinc biofortified potatoes have considerable potential to reduce zinc deficiency due to their low levels of phytate, an inhibitor of zinc absorption, and their high level of consumption especially in the Andean region. The purpose of this study was to evaluate fractional and total zinc absorption comparing biofortified potatoes with non-fortified potatoes in a test meal.

Methods: We undertook a randomized crossover study using a stable isotope approach in which 37 females consumed 1 kg/day of test meal from each biofortified and non-fortified potato. Venous blood samples and urine samples were collected in order to determine fractional and total zinc absorption.

Results: The zinc content of the biofortified potato was 0.47 ± 0.05 mg/100 grams and the non-biofortified was 0.31 + 0.03 mg/100 grams. The fractional zinc absorption of the biofortified variety was 18% lower than that of the non-biofortified (p <; 0.01). However, due to its higher zinc content, on average 24% more zinc was absorbed from the biofortified variety than from the non-biofortified variety (p<;0.01).

Conclusions: This study demonstrated that biofortified potato resulted in a significant increase on the total zinc absorption from a meal. This would be expected to contribute to reducing zinc deficiency in population where potatoes are a staple food. [Conflict of Interest Disclosure] The authors declared there was no conflict of interests [Further Collaborators] We acknowledge the valuable contribution of the following people: Olla Al-Jaibaji (Quadram Institute Bioscience), Eric Boy (HarvestPlus - IFPRI) and Richard Hurrel (ETH Zürich). We thank all the participants and field workers who made this study possible.

Keywords: Zinc absorption, Biofortified crops, Potato, Stable isotopes, Childbearing women

Conflicts of interests: none

PAB(T1)-116

Involvement of gastrointestinal hormones in the thermic effect of dietary protein in rats

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Background and objectives: Glucagon-like peptide-1 (GLP-1) is a gastrointestinal hormone secreted from enteroendocrine cells after a meal and has various postprandial physiological effects such as inducing satiety and suppressing blood glucose elevation via promoting insulin secretion. Among the three major nutrients, proteins potently stimulate GLP-1 secretion. Protein intake is a potent inducer of diet-induced thermogenesis, an important postprandial physiological effect. However, the involvement of GLP-1 is unknown. In this study, we examined the thermic effects of various nutrients, including dietary proteins, by measuring rectal temperature in rats, and the involvement of gastrointestinal hormones, including GLP-1, in this effect.

Methods: Rectal temperatures of rats fasted for 4 hours were measured using a thermocouple thermometer before (0 h) and after an oral administration of nutrients. In other studies, various antagonists were administered intraperitoneally immediately after an oral protein administration, and rectal temperature was measured as above. Each test was performed under awake, normal housing conditions (22°C).

Results: Of the energy-producing nutrients (isocaloric carbohydrates, lipids, and proteins), oral administration of protein raised rectal temperature the most. Among five dietary proteins (casein, whey, rice, egg, and soy) examined, soy protein had the highest thermic effect. This rectal temperature increase was attenuated by intraperitoneal administration of a GLP-1 receptor antagonist (exendin-9). In contrast, various receptor antagonist treatments of other representative gastrointestinal hormones, GIP, CCK, and PYY, had no effect. In addition, intraperitoneal administration of propranolol, a nonselective beta-adrenergic receptor blocker, did not affect the rectal temperature increase induced by soy protein administration.

Conclusions: These results suggest that soy protein induces postprandial body temperature increase via GLP-1 signaling, independently of brown adipose tissue activation.

Keywords: gastrointestinal hormone, glucagon-like peptide-1, dietary protein, thermic effect, diet-induced thermogenesis

Conflicts of interests: none

PAB(T1)-117

Hyperspectral imagery and machine learning assisted dietary assessment; classifying toppings in between double breaded sandwiches

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Background and Objectives: Dietary assessment has proven to be an invaluable tool in efforts to reduce prevalence of nutrition related non-communicable diseases. To improve the current dietary assessment tools, machine learning is applied to automatically detect food items in images based on shape, size, color, and texture. Hyperspectral imaging (HSI) is emerging as a relevant addition to automated dietary assessment. Near infrared or shortwave infrared light measured by HSI can provide information about food chemical composition beyond surface level. We propose a proof of concept where machine learning applied to HSI looks inside a combined food item, i.e. closed sandwiches, to automatically detect their composition.

Methods: For data acquisition, sandwiches were assembled with white or wholewheat bread, optional butter, and six different toppings. Hyperspectral data was captured with the IMEC SWIR Snapscan using 108 bands in the range [1116.141162nm, 1670.623839nm]. Data pre-processing, including spectral filtering and ROI selection, reduced each hypercube (n=24) with dimensions (512, 640, 108) to a region of interest with dimensions (200, 100, 108) and finally to individual pixels (20,000, 180). Data (n=480,000) were randomly split into a train set (n=336,000), used to train a multilayer perceptron on sandwich contents, and a test set (n=144,000) to predict the characteristics of previously unseen pixels to evaluate the performance of the model.

Results: The accuracy score for the classification of bread type was 0.8322, 0.5922 for presence of butter, and 0.2652 for classification of toppings. All classifications performed better than random.

Conclusions: Most test errors were found in sandwiches with high nutritional overlap, e.g., fatty cheese versus low fat cheese and butter. Changing the hyperspectral capturing range may improve the error rate, other wavelengths could be considered to reliably measure the light penetrating the lowest layers of the sandwich. Due to nutritional overlap the training labels are not represented as mutually exclusive. The model might improve by predicting macronutrients instead of the components of the sandwich. This work indicates that machine learning applied to HSI can automatically detect food composition beyond surface level and shows that these technologies are a promising pursuit to improve automated dietary assessment.

Keywords: dietary assessment, machine learning, hyperspectral imaging, food composition

Conflicts of interests: none

PAB(T1)-118

A randomized controlled trial of long-term nicotinamide mononucleotide supplementation in healthy adults

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Background and objectives: Numerous preclinical studies have shown that nicotinamide mononucleotide (NMN) supplementation promotes epigenetic rejuvenation and reverse metabolism and function in aged organs and tissues. However, there is limited evidence on the clinical efficacy and safety of NMN. In this study, we evaluated how a 12-week NMN supplementation affects metabolic health parameters in humans.

Methods: Thirty-six healthy male and female participants were enrolled in this randomized, double-blinded, placebo-controlled, parallel study. Participants ingested one capsule of either 125 mg NMN or placebo twice a day after meals for 12 weeks.

Results: NMN supplementation significantly increased the blood levels of the NAD metabolite nicotinamide, indicating that the ingested NMN was utilized in the blood. These results indicate that long-term NMN supplementation at a dose of 250 mg/day is safe and effectively elevates nicotinamide adenine dinucleotide (NAD+) metabolism in healthy middle-aged adults. We also found that a 12-week supplementation with 250 mg NMN tended to reduce brachial-ankle pulse wave velocity (baPWV) values, although no significant differences were observed between the two groups.

Conclusions: This study reveals that long-term NMN supplementation in healthy middle-aged individuals is safe, and beneficial for activating NAD+ metabolism and reducing baPWV. To our knowledge, this study is the first to show that NMN supplementation could help reduce cardiovascular diseases risk and may be useful for advancing larger-scale studies in the future.

Keywords: NMN, anti-aging, NAD, Vitamin B, Sirtuin

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-119

Effects of Vitamin C deficiency on increased anxiety-like behavior induced by social-defeat stress in mice Taiga

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Background and objectives: We have previously shown that Vitamin C (VC) deficiency for 1 week increases anxiety-like behavior in osteogenic disorder Shionogi rats, which are unable to biosynthesize VC. To investigate the effects of VC deficiency on stress-induced behavioral changes, we measured anxiety-like behavior under social-defeat stress using senescence marker protein–30 (SMP30)/gluconolactonase (GNL) knockout (KO) mice, which are unable to biosynthesize VC.

Methods: 3-week-old male SMP30/GNL KO mice were divided into two groups; one was provided with water containing sufficient amount of VC (VC+) and the other with water without VC (VC-) for 42 days. On days 25–34, half of the mice in each group were exposed to social-defeat stress by being repeatedly subjected to larger and aggressive ICR mice (S+), while the other half were not exposed to social-defeat stress (S-). On days 35–38 and 41, anxiety and depression levels were assessed by the elevated plus maze test (EPMT), open field test (OFT), and tail suspension test (TST), respectively. Dissection was performed on day 42; plasma and organs were collected, and the levels of plasma and brain VC, brain neurotransmitters, plasma corticosterone, and brain TBARS were measured.

Results: Body weight did not differ significantly among the four groups throughout the experimental period. Total VC levels in plasma and cortex were significantly reduced by VC deficiency. In the EPMT, mice in the VC-/S+ group did not appear in the open arm for the first 5 minutes and demonstrated significantly reduced open arm activity compared with that of the mice in the VC+/S+ group; however, decreased open arm activity due to VC deficiency was not observed in the non-stressed mice. Center area activity in the OFT was decreased and plasma corticosterone level was increased owing to social-defeat stress but was not affected by VC deficiency. In the TST, there were no significant differences in immobility time among groups. Prefrontal cortex dopamine levels were significantly reduced and cerebellar TBARS levels were significantly increased by VC deficiency but were not affected by social-defeat stress.

Conclusion: Vitamin C deficiency augments increased anxiety-like behavior with social-defeat stress in the EPM test.

Keywords: Vitamin C, anxiety-like behavior, SMP30/GNL knockout mice, social-defeat stress, corticosterone

Conflicts of interests: none

PAB(T1)-120

NMN reduces oxidative stress by increasing NQO-1 expression through SIRT1 activation in HUVECs

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Background and objectives: Oxidative stress causes endothelial dysfunction associated with vascular aging and is causally related to the pathogenesis of cardiovascular diseases. Preclinical studies indicate that a nicotinamide adenine dinucleotide (NAD+) precursor nicotinamide mononucleotide (NMN) restores age-related NAD+ depletion and alleviates oxidative stress in aged vessels, providing vasoprotective effects. However, few studies have investigated how NMN reduces vascular oxidative stress at the cellular level. We aimed to identify a possible mechanism that underlies the protective effect of NMN on oxidative stress.

Methods: Human vascular endothelial cells (HUVECs) were pretreated with NMN for 24 h and then stimulated with hydrogen peroxide (H2O2). Cell viability was assessed by WST-8 assay. The mRNA and protein expressions were analyzed by qPCR and western blotting, respectively. Actin cytoskeleton was visually evaluated using immunostaining and fluorescence microscope. Cellular reactive oxygen species (ROS) levels were measured with a microplate reader using the fluorescent CM-H2DCFDA probe.

Results: NMN inhibited H2O2-induced cell death, disorganized actin cytoskeleton, and cellular ROS production. In addition, NMN also suppressed the expression of senescence-associated proteins, including p16 and p21, in H2O2-treated HUVECs. We found that NMN increased mRNA and protein expression of an anti-oxidant enzyme NAD(P)H: quinone oxidoreductase 1 (NQO-1). Interestingly, the expression of NQO-1 markedly increased after NMN treatment, whereas the increase in other nuclear factor erythroid 2-related factor 2 target gene expressions were modest. A SIRT1 inhibitor EX527 abrogated the effect of NMN on NQO-1 expression, suggesting that NMN-inducible NQO-1 is involved in SIRT1 activity.

Conclusions: NMN regulates oxidative stress by modulating NQO-1 expression via activating the SIRT1-dependent pathway and provide a new insight into the mechanism by which NMN exert protective effects on vascular oxidative stress.

Keywords: Nicotinamide mononucleotide, Oxidative stress, Vascular endothelial cell, Nrf2, Senescence

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T1)-121

Detection of serum unmetabolised folic acid at 36 weeks' gestation in pregnant women taking multi-vitamin and mineral supplements with or without 800 µg folic acid

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Background: Folic acid (FA) containing supplements are recommended for women who are planning to get pregnant, one month before conception up to 12 weeks of gestation to prevent neural tube defects. There are suggestions that increased FA intake in late gestation has been associated with adverse health outcomes in children. Excess circulating FA as 'unmetabolised folic acid' (UMFA) has been proposed as a biomarker of excess. Our aim was to determine if removing FA from prenatal supplements after 12 weeks' gestation reduces maternal serum UMFA concentration.

Methods: A double-blind, parallel group, randomised controlled trial. Women between 12 and 16 weeks' gestation were randomised to receive a daily multi-vitamin and mineral supplement containing 800 µg of FA or no FA from enrolment until delivery. The primary outcome was serum UMFA concentration at 36 weeks' gestation. Secondary outcomes included serum and erythrocyte folate concentrations. UMFA concentrations were determined using a multiple reaction monitoring assay on a triple quadrupole mass spectrometer. Serum and erythrocyte folate concentrations were measured using microbiological assay.

Results: Eighty seven percent (n=90/103) women completed the trial. The proportion of women with detectable UMFA was significantly lower in the no FA group compared to the 800 µg FA group (71.7% vs. 97.7%]; p = 0.001), but a mean difference could not be quantified. Maternal serum and erythrocyte folate concentrations were significantly lower in the no FA group compared to the 800 µg FA group at 36 weeks' gestation (23.2 vs. 49.3 nmol/L, 1335 vs. 1914 nmol/L, respectively; p<; 0.001).

Conclusions: Although removing folic acid from supplements reduced the proportion of women with detectable UMFA, serum concentrations were low overall. This suggests UMFA may not be the best biomarker to determine chronic excess folic acid exposure. Further work is needed to establish if excess folic acid in late pregnancy contributes to adverse childhood clinical outcomes.

Keywords: folate, unmetabolised folic acid, pregnancy, neural tube defects, erythrocyte

Conflicts of interests: SW serves as a consultant at InovoBiologic Inc, AB, Canada. All other authors declare no conflict of interest.

PAB(T1)-122

The association between ultra-processed foods and atherogenic lipoproteins is partly mediated by microbiome in the ZOE PREDICT study

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Background and objectives: Ultra-processed food (UPF) intake is associated with unfavourable cardiometabolic outcomes, although mechanisms are unclear. The aims of this study were to; 1) characterise cardiometabolic risk measures associated with level of intake of UPF, unprocessed and minimally processed foods (MPF), and 2) identify partially mediating gut microbial species.

Methods: The NOVA classification was applied to weighed food diaries (14 days) from the UK ZOE PREDICT 1 cohort (n = 966) collected by mobile application. Metagenomic microbiota samples were collected prior to clinic visit, anthropometric measures and serum lipid based metabolomics were assessed at clinic visit. Linear mixed effect model, PERMANOVA and mediation analyses explored associations between level of food processing, cardiometabolic risk measures and the gut microbiota after adjusting for confounders (sex, age, race/ethnicity, smoking, education, physical activity, zygosity and family number).

Results: In a free-living setting UPF intake was strongly associated with nutrient intakes; higher carbohydrate and total sugar intake, and lower alcohol and protein intake (all %EI) (p <;0.001 for all) but not mean energy intake (kcal) or body weight (kg). UPF intake was associated with increased abdominal obesity (beta = 0.003, p = 0.01) and an atherogenic lipoprotein phenotype (elevated triglycerides, ApoB/ApoA1 and lower L-HDL subparticles) (P<;0.05 for all). The gut species, Roseburia hominis, was negatively associated with UPF intake (beta -0.015, q = 0.003), and partially mediated the associations of UPF with atherogenic lipoproteins (triglycerides, serum monounsaturated fatty acids (MUFA)). Conversely, MPF intake was associated with a favourable lipoprotein profile, reduced GlycA concentrations (beta = -0.8 x10-4, p = 0.05) and lower visceral fat mass (beta = -2.89, p = 0.02), all partially mediated by multiple gut microbial species including F. plautii.

Conclusion: An unfavourable association between UPF and atherogenic lipoproteins, independent of energy intake or body weight, highlights a novel potential mechanism linking modern food processing with ill-health. The role of the gut microbiota adds to the growing body of evidence for key diet-microbiome-host health interactions.

Further Collaborators: Nicky Hornzee, Abigail J Johnson,

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Keywords: Nutrition, Ultra-processed foods, NOVA, Microbiome, Diet

Conflicts of interests: TDS and JW are co-founders of ZOE Ltd (ZOE). FA, NS, PWF, LMD, AMV and SEB are consultants to ZOE. ERL, IL, JW, RD, LEF, and NH are employed by ZOE. Other authors have no conflict of interest to declare. The study sponsors (ZOE) contributed as part of the Scientific Advisory Board in the study design and collection.

PAB(T1)-123

Prevention of dietary obesity: Impact of N-3 polyunsaturated fatty acids on autophagy process in connection with the colonic mucus layer secretion and the gut microbiota

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Background and objectives: During the onset of dietary obesity, a dysbiosis of the intestinal microbiota contributes to the alteration of the intestinal barrier function by increased permeability of the intestinal epithelium, and alteration of the colonic mucus layer linked to low grade inflammation. It has recently been shown that an autophagic process is essential for the exocytosis of mucin granules by intestinal caliciform cells. Our hypothesis is that, in the context of an obesogenic diet, n-3 polyunsaturated fatty acids (n-3 PUFAs) could modulate this autophagic process at the colonic level and thus prevent the alteration of the barrier function and the intestinal homeostasis.

Methods: To do so, four groups of Wilde Type (WT) and fat1 mice (with tissue enrichment in n-3 PUFA) were fed with an obesogenic (HFD) or control (CTL) diet for 12 weeks. Weight monitoring and a glucose tolerance test were performed. The expression of proteins and autophagy genes (LC3B, ULK1, ATG5) as well as the mucin MUC2 were analyzed, the measurement of the thickness of the mucus layer was performed after staining with alcyan blue. Finally, the composition of the mucus layer was assessed by electron microscopy. In addition, four groups of Wilde Type mice were transplanted with, either caecal content of fat1 (WTF) or Wilde Type mice (WTWT), then were fed with an obesogenic (HFD) or control (CTL) diet for 12 weeks. In the same way, weight monitoring, glucose tolerance test and the measurement of the thickness of the mucus layer were performed. The expression of proteins and autophagy genes as well as MUC2 were analyzed.

Results: Our results show that unlike WT HFD mice, fat1 HFD mice were protected against dietary obesity, glucose intolerance, the intestinal permeability and the increased of the thickness of the mucus layer. Furthermore, regardless of diet, the expression of the initiation and elongation autophagy genes ULK1, ATG5 and LC3B tended to increase.

Conclusions: Finally, WTF HFD mice were able to partially reverse weight gain and to normalize glucose tolerance. They were protected from the alteration of the thickness of the mucus layer barrier compare to WTW HFD and the expression of autophagy genes ULK1 and LC3 tended to increase. It would be now interesting to investigate the composition of fat1 gut microbiota and study its effect on mucus secretion during obesity. It would also be interesting to study the effect of short-term obesogenic diet on the thickness of the mucus layer because, according to previous studies, 4 weeks of High fat diet was sufficient to induce a significant reduction of the thickness of the mucus layer.

Keywords: dietary obesity, nutrition prevention, N-3 polyunsaturated fatty acids, colonic mucus, autophagy

Conflicts of interests: none

PAB(T1)-124

Micronutrient Dose Response (MiNDR) study among women of reproductive age (WRA) and pregnant women (PW) in rural Bangladesh: study protocol for a double-blind, randomized, controlled trial

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Background and objective: Improving nutritional status of women can benefit their own health, prepare them for pregnancy, support nutritional needs during pregnancy, improve pregnancy outcomes, and impart nutrient stores to offspring in utero and during lactation. A multiple micronutrient supplement (MMS) (with "UNIMMAP" the most common formulation, containing ~1 RDAof 15 micronutrients) is superior to the current standard of care for antenatal use, iron-folic acid (IFA), at reducing adverse birth outcomes. MMS has been recommended for use in the context of rigorous research by WHO. However, while MMS improves pregnancy outcomes, it might not completely resolve vitamin and mineral deficiencies in undernourished settings. We aim to conduct a bioefficacy study using different doses of a MMS product to determine a minimum dose at which sufficiency is achieved for a variety of micronutrients. Secondary objectives are to discover novel functional biomarkers of nutrient status and examine response based on baseline characteristics and underlying nutritional status.

Methods: In rural northern Bangladesh, two dose-response trials (n=240 participants/trial) using a double-blind, randomized, controlled design will be conducted to test increasing levels of a variety of micronutrients, some of which will be between RDA/ AI and the UL. These four-arm trials will be done among WRA and PW and test three different levels of

nutrients vs a control of ~1 RDA, similar to the UNIMMAP formulation. Balanced energy and protein (BEP) supplementation will be done simultaneously to ensure adequate protein and caloric intakes. Features of the trials will include gestational assessment using ultrasound (PW), directly observed supplementation, diet and morbidity recalls, understanding side effects, and monitoring adverse events and state-of-the-art biochemical analytics, with creation of a biospecimen repository of blood, urine, stool, and human milk specimens. Statistical modelling will be used to determine the amount of each nutrient at which nutritional status for the group is optimized without evidence of nutrient excess.

Results: To be determined. These findings will be pertinent to a large swathe of the rural South Asian population.

Conclusions: This study is an important undertaking to fill a large knowledge gap regarding optimal levels of nutrient intakes to achieve adequate status, especially in settings where long-standing micronutrient deficiencies exist among WRA and PW.

Further Collaborators: Ethan Gough from Johns Hopkins Bloomberg School of Public Health, Baltimore, MD USA. Michael Rosenblum, Mathangi Gopalakrishnan, and Joga Gobburu from Center for Translational Medicine, University of Maryland School of Pharmacy, Baltimore, MD, USA. Klaus Kraemer from Sight and Life, Basel, Switzerland

Keywords: Micronutrient supplementation (MMS), Balanced energy and protein (BEP) product, Dose response, Birth outcome

Conflicts of interests: On behalf of the MiNDR study team, the author(s) declare(s) that there is no conflict of interest.

PAB(T1)-125

Effect of eating rice balls (Onigiri) as a supplementary food after training in college student middle-distance track and field athletes on subjective fatigue after exercise and after the next day

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Background and objectives: Cooked rice is one of the foods whose main ingredient is α-starch, which is one of the polysaccharides, and Japanese people prefer to eat as “rice balls (Onigiri)”. Elite athletes also eat “Onigiri” for important competition and recovery on site, but few studies have objectively measured the effect of “Onigiri” on after exercise recovery from fatigue. In this study, we compared the effect of eating “Onigiri” as a supplementary food after training within 30 minutes subjective fatigue and hunger from the next day onwards, and compared it with physiological data, aimed to verify the effectiveness of “Onigiri”.

Methods: The subjects were 7 male college student middle-distance track and field athletes, were participated in the experiment that take supplementary food (Onigiri) immediately after training and the control that don't take anything (control group) by crossover trial method. “Onigiri” was prepared as follows so that the intake of carbohydrates was 1.1g/kg of body weight: omelet and ham in Energy:384-465kcal, Carbohydrate:62.2-80.0, Protein:12.6-13.8g, Fat:7.7-7.8. All subjects ate lunch 2 hours after the end of training. For 3 days before and after training, changes in blood glucose levels were observed using a continuous glucose monitoring (CGM), and dietary surveys were also conducted. Furthermore, we surveyed the physical condition, subjective fatigue and hunger questionnaire.

Results: In changes in blood glucose levels was higher the control group than the experiment at 3:00, 4:00, and 5:00, and tended to be higher the control group than the experiment at 6:00 and 7:00 from bedtime to early morning on the day after training. They were observed significant interaction. In the subjective fatigue questionnaire after training, "fatigue" was higher the control group than the experiment, and "hunger" was tended to be higher the control group than the experiment.

Conclusions: In this study, “Onigiri” may affect glucose metabolism and may be a suitable food as a portable supplementary food after training. In the future, it will be necessary to conduct comparative experiments and laboratory experiments to investigate in detail whether “Onigiri” has psychological factors such as preference as factors that affect subjective fatigue.

Keywords: M rice balls, supplementary food, recovery, subjective fatigue, continuous glucose monitoring

Conflicts of interests: none

PAB(T1)-126

Butyrate-induced anti-obesity effects via changes in gut microbiome and muscle oxidative metabolism

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Background and objectives: A large body of evidence has convincingly demonstrated the impact of the gut microbiota and microbially-produced metabolites such as butyrate on obesity. However, it remains to be elucidated whether and how butyrate intake as diet influences gut microbiome and body weight control. This study was aimed to investigate effects of butyrate supplementation on diet-induced obesity (DIO) and their underlying molecular mechanisms.

Methods: The 5-week-old Sprague Dawley male rats were divided into three groups: high-fat diet (HFD), short- and long-term sodium butyrate-supplemented HFD (SSB and LSB) for two or fourteen weeks, respectively. Tissues and feces were collected, and the mRNA and histone were extracted from tissues for quantitative analysis. The feces were used for 16S

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

rRNA gene sequencing for microbial analysis.

Results: Dietary butyrate supplementation attenuated weight gain in LSB, despite augmenting food intake, compared to HFD group. The colonic proglucagon (Gcg) gene, encoding appetite suppressing hormone glucagon-like peptide (GLP-1), was downregulated in LSB along with elevated food intake. The fecal energy output was not changed, indicating that prevention of DIO was not caused by energy output. Gut microbiome analysis showed a higher abundance of Firmicutes in LSB with increasing tendency of Firmicutes and Bacteroidetes (F/B) ratio than HFD. Additionally, butyrate supplementation reduced species evenness of alpha-diversity and increased beta-diversity. The butyrate transporter encoding gene solute carrier family 16 member 1 (Slc16a1) was upregulated in muscle, but not the liver and adipose tissue, suggesting increased butyrate influx into the muscle cells. Additionally, peroxisome proliferator-activated receptor gamma (Pparγ), Pparδ, and fatty acid oxidation-related genes, including PPARγ coactivator 1-alpha (Pgc1α) and uncoupling protein 2 (Ucp2) were upregulated in LSB and SSB. Consistent with gene expression results, the global acetylation levels of histone H3 and H4 of LSB were only elevated in muscle, not in the liver. Interestingly, butyrate prevented weight gain, likely via changes in microbiota and muscle oxidative metabolism.

Conclusions: These results pointed a distinct role of dietary butyrate in regulating muscle histone acetylation and gene expression, and consequently anti-obesity effect. Further studies are required to elucidate how the butyrate affects gut microbiota.

Keywords: Butyrate, Short chain fatty acids, Microbiome, Diet-induced obesity, Anti-obesity

Conflicts of interests: none

PAB(T1)-127

FADS1 and FADS2 as biomarkers of Zn status – a systematic review and meta-analysis

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Introduction: Despite enormous research efforts, a single sufficiently sensitive and reliable biomarker for the assessment of Zn status has not been identified to date. Over the recent years, several new indicators have been proposed as potential candidates for more accurate determination of Zn status, one of them being FADS1 and FADS2 activity. Aim: The objective of the current work was to do a systematic review of experimental animal and human studies on the efficacy of FADS1 and FADS2 to respond to Zn interventions and to define the current applicability and suitability of FADS activities to act as biomarkers of Zn status in humans.

Methods: A systematic review was conducted following PRISMA guidelines. The systematic search was performed in PubMed, Web of Science, Scopus, Web of knowledge, and Central with strictly defined criteria. Risk of bias was assessed with RoB2 tool in randomized controlled trials, Newcastle-Ottawa Scale in cross-sectional studies and with SYRCLE tool in animal studies.

Results: 21 studies were included, 8 animal and 13 human studies (5 randomized controlled, 2 feeding non-controlled trials and 6 cross-sectional studies). The qualitative synthesis demonstrates the potential of FADS1 and FADS2 activity to be used as additional biomarkers of Zn status. The activity of desaturase enzymes corresponds to dietary Zn manipulations, both in animals and humans and potential covariates and confounders of these relations are identified. The changes in FADS2 activity and plasma/serum Zn following a Zn intervention in both cases demonstrate that the pooled estimates were not significant, however, the standard mean difference of FADS2 activity was higher.

Conclusion: This review provides a summary of major findings and some novel insights on FADS1 and FADS2 activities in relation to Zn intake. Additional higher quality experimental animal model studies and clinical trials are necessary to evaluate the observed interrelations further. The work provided should be used as a guideline for conducting future clinical trials that will explain the proposed relationships further and assist in confirming the efficacy of the FADS1 and FADS2 activity to act as Zn status indicators, individually or in combination with some other biochemical markers.

Keywords: Zinc, FADS1, FADS2, biomarker, Zn deficiency

Conflicts of interests: none

PAB(T2)-1

Consumption of high protein foods and their impact on health of Mauritians

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Background and Objectives: Dairy products and pulses are rich sources of proteins and can be used as substitutes for red meat, chicken and eggs which, apart from being protein-rich foods, are also high in saturated fats and cholesterol. The aim of this study is to investigate whether or not Mauritians know the importance of dairy products and pulses as alternative and rich sources of proteins, whether these are included in their daily diets, and their impact on health.

Methods: A survey-based questionnaire was designed to carry out a cross-sectional study among 500 respondents. Questions included were on socio-demographic factors, socio-economic factors, lifestyle factors, health and nutritional status, and consumption pattern of red meat, chicken, eggs, dairy products and pulses.

Results: Data showed that although a majority of respondents knew the importance of dairy products and pulses as rich sources of proteins in the diet, they did not consume these adequately. Respondents who consumed more of these

foodstuffs everyday were consequently healthier than respondents who consumed red meat, chicken or eggs on a daily basis. Links were found between daily dairy product and pulses consumptions and low prevalence of non-communicable diseases among the respondents who consumed more of these foods, as opposed to those who consumed red meat, chicken or eggs everyday.

Conclusion: The study revealed that awareness must be raised on the importance, health impacts and on the adequate inclusion of alternative protein food sources such as dairy products and pulses in the daily diet of Mauritians.

Keywords: Dairy products, Pulses, High protein foods

Conflicts of interests: none

PAB(T2)-2

Systematic error and association between total protein intake from Food Frequency Questionnaire and from the gold standard differ between individuals with low- and high-socioeconomic status in a Dutch general population

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Background and objectives: Adequate nutritional assessment is particularly important in individuals with low socioeconomic status (SES) to better predict disease outcomes, given their vulnerability to a whole spectrum of diseases. Dietary intake of nutrients, including protein intake, is commonly assessed by means of food frequency questionnaires (FFQ). However, little is known regarding the difference in bias between subjects with low- and high-SES. This study investigated if total protein intake assessed from FFQ was associated with protein intake assessed from 24 h urine, and to what extent this association differed between individuals with low- and high-SES in a Dutch population.

Methods: We included 1302 participants aged 65 ± 4 years old from the Lifelines-MINUTHE cohort study, who had valid and reliable FFQ and 24 h urine data. SES was determined by education attainment and a total of 43.2% individuals had low SES. Total dietary daily protein intake was calculated from an externally validated FFQ as well as calculated from 24 h urine using Maroni's formula. We used linear regression analysis to examine the association between protein intake from FFQ and Maroni's formula, and to investigate whether this association was modified by SES.

Results: Overall, estimated protein intake from FFQ (0.92 ± 0.25 g/kg/d) was lower than from Maroni's formula (1.1 ± 0.28 g/kg/d). The difference of protein intake assessed from FFQ and urine was smaller in individuals with low SES than that of individuals with high SES (0.16 ± 0.29 g/kg/d and 0.22 ± 0.29 g/kg/d, p<;0.001). After adjusting for covariates, total protein intake from FFQ was positively associated with protein intake calculated from 24 h urine (β (SE): 0.65 (0.05), p<;0.001). SES modified the association (pinteraction= 0.01), with higher magnitudes of association observed among people with high SES (β (SE): 0.67 (0.06), p<;0.001), compared to people with low SES (β (SE): 0.63 (0.07), p<;0.001).

Conclusions: We found a positive association between objective and subjective assessment of protein intake. However, this association was less pronounced among people with low SES. Promoting objective assessment of nutrients might help mitigate the reporting bias among socioeconomically disadvantaged individuals, and therefore could better facilitate monitoring health conditions among them.

Keywords: protein intake, socio-economic position, reporting bias, objective nutrients assessment, dietary assessment

Conflicts of interests: none

PAB(T2)-3

The way of counseling system from Ages, Gender, Obesity, Hypertension and Hyperlipidemia differences for glucose tolerance abnormality considered by 75g OGTT

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Background: According to the Ministry of Health survey in 2019, the 19.7% of male and the 10.8% of female are strongly suspected of having diabetes in Japan. We know all that the early recognition of impaired glucose tolerance during a 75-g oral glucose tolerance test (OGTT) in patients with an HbA1c of 6.0-6.4 % is reducing to diabetic in the future. Objective: To show the past records of similar cases to the impaired glucose tolerance as well as to the future ones who are patients of the difference about age, gender, obesity, and hypertension and dyslipidemia.

Method: The objects came from the patients who tested OGTT from Jan.2017 to Oct.2021, and there were 129 people (79 male, 50 female,57.6± 12.9 years, 39 elderly people (over 65 years old), HbA1c:6.0-6.4% (6.2 ± 0.1%), BMI:26.7 ± 5.2kg/m2) were investigated due to their differences during the OGTT (0,0.5,1.0,1.5,2.0hour).

Result: Patients were to be classified into the normal type(11%), borderline type(68%), or diabetic type(21%).27 diabetic type patients(HbA1c6.24±0.15%) were higher than both 88 borderline type patients(6.16±0.13%) and 14 normal type patients (6.12±0.11%) (p<;0.05) (p<;0.01). The study also showed the average of OGTT of the patients over 65 years old and under 65 years old weren't significant, and the average of the patients over BMI25kg/m2 and under BMI25kg/m2 also weren't

significant. However, the average of OGTT (0.5h,1.0h,1.5h) of male was higher than female. The average age 42 patients of Hypertension and dyslipidemia(60.8±11.2years) were older than 31 patients without Hypertension and dyslipidemia(51.5±14.9years)(p<;0.01),and the group of 2.0hGTT(179.4±37.6 mg/dl) was higher than the group without Hypertension and dyslipidemia 2.0hGTT(159.7±43.7 mg/dl) (p<;0.05).

Conclusion: We recognized the difference of the gender for the impaired glucose tolerance. Also, the impaired glucose tolerance is reflected the people over 60 years old who has both hypertension and dyslipidemia was the high level of after 2hours glucose level. Before the result of OGTT, our tendency helps the consultation before being diabetic.

Keywords: 75g OGTT, Diabetes, Gender, Obesity, Hypertension

Conflicts of interests: none

PAB(T2)-4

Effect of potato salad intake on postprandial plasma glucose: Difference in the amount of seasoning added

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Objectives: The blood sugar easily increases after eating potatoes because the glycemic index of potato is high. As an example, potato salad is mainly made by potatoes and some vegetables like carrots and onions, but it also contains mayonnaise which may interfere with glucose metabolism. In this study, we examined the effects of potato salad on postprandial blood glucose and feeling satiety. We also examined the effects of the amount of mayonnaise added to the salad.

Methods: Thirty six healthy female university students were enrolled. They were asked to take three different meals, i.e., (1) potato-only meal, (2) a potato salad with high amount of mayonnaise, and (3) a potato salad with low amount of mayonnaise. The total amount of carbohydrate in each meal was adjusted to almost 30 g. In each experiment, blood sugar was measured from the fingertip before and 30, 45, 60, 90, 120 min after taking each meal. Visual Analogue Scale (VAS), an indicator of satiety, hunger and appetite, was also measured before and 30, 60, 120 min after taking each meal.

Results: The postprandial glucose after eating potato salad was significantly decreased and VAS was significantly increased compared to potato-only meal. Potato salad with high amount of mayonnaise prevented blood glucose increase more strongly than that with low amount of mayonnaise. Because mayonnaise contains a lot of fat, potato salad with high amount of mayonnaise contains 67% of fat while low amount of mayonnaise contains 45% of fat.

Conclusions: The fat in mayonnaise highly contributed to the prevention of the blood sugar increase. Also the dietary fiber of vegetables in the potato salad helped a little. In this study, even a small amount of mayonnaise suppressed the increase in blood glucose level. Therefore, it is advisable to adjust the amount of mayonnaise depending on the health condition of each person.

Keywords: potato salad, amount of seasoning, blood glucose level

Conflicts of interests: This study was funded by Kieikai Research Foundation.

PAB(T2)-5

Maternal time spent in childcare and its association with dietary adequacy among 12-23 months old rural Eastern Ugandan children

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Background and objectives: The causes of under-nutrition are multi-factorial but dietary adequacy and child care are important contributing factors. Maternal time constraints result in trade-offs between time in domestic and productive work, which might have a negative impact on child nutrition. The current study aimed to determine whether maternal time allocated to childcare or feeding the child was associated with dietary adequacy for children 12-23 months.

Methods: A cross-sectional survey was conducted in Eastern Uganda. Maternal time use data was collected using 15 –hour observation, child's dietary data was captured using 1-day weighed food record. Estimated percentage of children at risk of inadequate nutrient intakes was calculated using EAR fixed cut-point or probability approaches, after adjusting the intake distribution using external variance ratios and assuming low Fe & Zn bioavailability. Indicator of overall dietary adequacy used the mean probability of adequacy (MPA) for micronutrients based on the estimated best linear unbiased predictor (BLUP) of usual nutrient intakes.

Results: More than 30% of children were at risk of inadequate intake of Fe, Ca, Zn, thiamine, riboflavin, niacin, vitamin A, B6, folate, and B12 (ranging from 30-100%), although <;15% were at risk of low protein and vitamin C intakes. The median IQR for MPA was 0.41 (0.30, 0.57). Women spent on average 11.8 hours/day on child care of which 1.75 hours/ day, 2.5 hours/day and 0.5 hours/day were spent feeding, breastfeeding, and playing with the child, respectively. The majority of time spent in childcare was combined with other activities. Factors significantly associated with MPA included child feeding time (β=0.077; p<;0.001), child's breastfeeding status (β= 0.048; p<;0.005) and availability of an adult alternative childcare giver such as an older sibling or an aunt within the household (β= 0.053; p<;0.05).

Conclusions: The time spent in child feeding and the presence of alternative adult caregivers were positively associated with MPA. The results indicate the need for more care services and more engagement from adult care givers within the

household. These findings may have implications for policy and programme planning for children in the first 1000 days of life.

Keywords: Child care, Dietary adequacy, Maternal time
Conflicts of interests: none

PAB(T2)-6

Dexamethasone-induced muscle atrophy in rats: effects of age and vitamin D deficiency

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Background and Objectives: Since skeletal muscle plays an important role in energy metabolism, human health is supported by maintaining a suitable amount of the muscle. Age-related muscle loss is known as sarcopenia. Recent studies have suggested that vitamin D (VD) deficiency is related to sarcopenia, but mechanisms responsible for VD to maintain skeletal muscle are not clear. It has been reported that an overdose of dexamethasone (DEX) causes muscle atrophy and promotes the branched-chain amino acids (BCAAs) catabolism, suggesting that accelerated catabolism of the amino acids contributes to muscle atrophy. Therefore, the present study aimed to examine effects of VD deficiency on the BCAA catabolism and DEX-induced muscle atrophy in rats.We conducted 2 experiments. In Experiment 1, 9-week-old male rats were divided into two groups and either saline or DEX (600 µg/kg body weight) was intraperitoneally administered at 10:00 a.m. for consecutive 5 days. In Experiment 2, 5-week-old male rats were divided into two groups and fed either a control diet (AIN93G) or a VD-deficient diet (D18121302) for 8 weeks. At 14 weeks of age, each group of rats was divided into two subgroups, and then rats were given saline or DEX as in Experiment 1. On the final day of the experiment, rats were fasted for 6 hours and anesthetized with isoflurane, and then blood and tissues were collected.DEX administration decreased muscle weights of tibialis anterior and gastrocnemius+plantaris by 29% and by 23%, respectively, in Experiment 1, and by 18% and by 17%, respectively, in Experiment 2. Soleus muscle weight was not affected by DEX administration in either experiment. These results suggesting that the skeletal muscles consisting mainly of white muscles in younger rats are susceptible to the DEX treatment. The DEX treatment significantly elevated the concentrations of plasma insulin and BCAAs, the former suggesting insulin resistance and the latter suggesting promotion of protein degradation. The VD deficiency did not affect muscle atrophy or plasma concentrations of insulin and BCAAs, suggesting VD deficiency did not promote DEX-induced muscle atrophy or insulin resistance.

Keywords: Dexamethasone, Vitamin D, BCAAs, Skeletal muscle atrophy, Insulin resistance
Conflicts of interests: none

PAB(T2)-7

A novel method for measuring serum albumin redox state using a thiol-binding reagent.

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Background and objectives: Albumin is the most abundant serum protein, comprising a mixture of human mercaptalbumin (HMA, reduced albumin) and nonmercaptalbumin (HNA, oxidized albumin), depending on the redox state of the cysteine residue at position 34. The redox state of serum albumin has been viewed as an oxidative stress biomarker, and recent studies have found its potential as a protein nutrition biomarker (Tabata et al., Antioxidants 2021). Serum albumin redox state has normally been measured using HPLC. However, this requires an expensive equipment and laborious technique, and is not feasible in many clinical practices. To overcome these limitations, we developed a simple method to evaluate albumin redox state by separating HMA and HNA, using a thiol-binding reagent and detecting albumin fractions in colorimetric assays.

Methods: HMA in serums of healthy adult volunteers (20 samples) were removed by reacting the free thiol group of HMA with a pyridyl disulfide-linked resin, e.g., a Cytiva Activated Thiol Sepharose 4B, or a Thermo Scientific EZ-Link HPDP-Biotin in combination with a Streptavidin Agarose Resin; HNA-containing fractions were then separated by ultrafiltration. Albumin concentrations in both serums (HMA+HNA) and the HNA-containing fractions were measured by a colorimetric method with bromocresol green (BCG) or bromocresol purple (BCP), and the ratio of HMA to total albumin (%HMA) was determined. The %HMA measured by the above method was then compared with the %HMA determined by a conventional HPLC method.

Results: Removal of HMA from the serums, i.e., the purity of HNA in the HNA-containing fraction, was confirmed by HPLC. Simple linear regression analyses indicated that %HMA by this method and the one by HPLC were correlated significantly (r = 0.614-0.910).

Conclusions: This novel and simple approach can be a valuable tool for measuring serum albumin redox state, a potential protein nutrition biomarker as well as an oxidative stress biomarker, in a variety of clinical settings.

Keywords: albumin, biomarker, serum albumin redox state, thiol-binding reagent
Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-8

Dietary calcium intake and obesity association according to alcohol drinking and smoking status in Japanese type 2 diabetes mellitus patients

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Background and objectives: Many previous studies have reported an inverse association between higher dietary calcium or dairy products intake and obesity or metabolic syndrome. Even though many studies have assessed this association, the effect of cofactors on this relationship have not been fully investigated. Therefore, we aim to conduct a cross-sectional study between calcium intake and obesity as measured by the body mass index (BMI) with stratification by cofactors including alcohol drinking and smoking status in Japanese people with Type-2 diabetes.

Methods: This was a cross-sectional study which included Japanese outpatients with Type 2 diabetes (n=1567; 63.1% men; mean age 62.3 SD 11.6 years). Diet information was collected via a self-administered validated food frequency questionnaire. Height and weight were self-reported and obesity was defined as BMI >;=25kg/m2.

Results: Multivariate analysis with adjustment by life-style confounders and energy intake resulted in an inverse association between quartiles of calcium intake and obesity in all participants (OR=.426, 95% CI= .292-.621; p trend= <;.001) and in all subgroups of the stratified analysis. Inclusion of vegetable intake in the multivariate analysis resulted in no association in the alcohol drinkers and smokers subgroups, while further adjustment by a number of food groups including soybeans, milk and other dairy products or bread intake was necessary for the inverse association to disappear in all participants, non-alcohol drinkers and never smokers subgroups. The nutrient-adjusted multivariate analysis showed that phosphorous and retinol, but not vitamin D, were important confounders, as the adjustment by these micronutrients resulted in a loss of significant association between calcium with obesity.

Conclusion: Higher quartile of calcium intake was inversely associated with obesity, but more strongly in non-alcohol drinkers and never smokers subgroups. There was a lower intake of dairy products by members of alcohol-drinkers and smokers subgroups. In addition, dairy consumption increased as rice intake decreased. Future research assessing dairy products intake by fat content and obesity in adult population is recommended.

Keywords: Dietary calcium intake, Obesity

Conflicts of interests: This work was supported by the Ministry of Health, Labour and Wellfare of Japan. The sponsors had no role in the design and conduct of the study, collection, management, and interpretation of the data, or preparation, review or approval of the manuscript. Hirohito Sone is the guarantor of this work and, as such, had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

PAB(T2)-9

Exploring strategies to improve the surveillance of iron deficiency

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Background and objectives: When national population-based estimates of iron deficiency (ID) are unavailable, clinical data may be useful for surveillance of ID. Our objective was to compare clinically used iron and hematologic indictors to the WHO recommended iron indicator to assess ID among a population of adult women.

Methods: Using data from the United States' National Health and Nutrition Examination survey (2003-2006 and 2017-2018, years when all indicators measured), we evaluated the sensitivity, specificity, and area under the receiver operating characteristics (ROC) of indicators used in clinical settings (hemoglobin, Hb <;12.0 g/dL; transferrin saturation, TSAT <;15%; total iron binding capacity, TIBC >;400 µg/L; serum iron, SI <;40 µg/L; and mean corpuscular volume, MCV <;80 fl) compared to inflammation-adjusted serum ferritin (<;15 µg/L) for ID among non-pregnant women aged 20-44 years (n=2,580).

Results: Prevalence of ID based on inflammation-adjusted serum ferritin was 18.0% and ranged from 6.1% (MCV) to 17.4% (TSAT) using alternative indicators. Sensitivity was greatest for Hb (74.4%), followed by MCV (66.5%), SI (61.2%), TIBC (52.9%), and TSAT (51.2%). Specificity was greatest for TSAT (90.6%), followed by TIBC (87.4%), SI (86.5%), Hb (85.2%), and MCV (83.8%). The ROC curve was greatest for TSAT (AUC=0.84), followed by TIBC (AUC=0.81), Hb (AUC=0.81), SI (AUC=0.79), and MCV (AUC=0.76).

Conclusion: When ferritin is unavailable, other iron indicators may be suitable for surveillance of ID among non-pregnant women in the United States. This exercise could be repeated to improve the estimation of ID where clinical data are available.

Keywords: Surveillance, Nutritional assessment, Electronic health records, Iron biomarkers

Conflicts of interests: none

PAB(T2)-10

Breakfast skipping habits affect dietary intake in Japanese athletes

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Background and objectives: Skipping breakfast has been reported to reduce daily energy and protein intake in healthy individuals. However, few studies have examined intake levels in athletes with breakfast skipping habits. Since athletes have higher energy expenditure than regular healthy individuals, more energy and nutrient intake are required. Therefore, if athletes skip breakfast, there is a risk of accelerating performance degradation. This study aimed to assess the nutritional intake and examine the relationship between nutritional intake and food group intakes among athletes with breakfast skipping habits.

Methods: A total of 177 male collegiate athletes from various sports (18 sports) participated in this study. Participants were classified into two groups based on the breakfast skipping habits: breakfast skipper (BS, 0–3 times) and the breakfast eater (BE, 4–7 times). Body weight and body composition were measured by bioelectrical impedance analysis. Habitual energy, nutritional, and food group intakes using the Food Frequency Questionnaire for Japanese Athletes (FFQJA) were investigated. Estimated energy requirement (EER) was obtained by multiplying athletes' resting energy expenditure estimation equation based on fat-free mass by physical activity levels.

Results: Body composition was not significantly different between the BS and the BE groups. The median difference between EER and energy intake level was significantly lower in the BS group than in the BE group (BS: -659 kcal, BE: -376 kcal, p<;0.05). The median intakes of protein, fat, calcium, iron, vitamin B2, and dietary fiber were significantly lower in the BS group than in the BE group. Furthermore, the food group intakes of soybean products and milk and dairy products were significantly lower in the BS group than in the BE group (p<;0.01, respectively). The daily intakes of soybean products and milk and dairy products were positively correlated with protein, fat, calcium, iron, vitamin B2, and dietary fiber levels.

Conclusions: This study indicated that athletes with breakfast skipping habits had lower energy, nutrients, and food group intakes. Breakfast intake that includes soybean products and milk and dairy products might improve nutritional status in athletes with breakfast skipping habits.

Keywords: breakfast skipping, athletes, Food Frequency Questionnaire for Japanese Athletes

Conflicts of interests: none

PAB(T2)-11

The relationship between “home cooking” and dietary outcomes: A scoping review of definitions and assessment methods

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Background and objectives: Epidemiological findings regarding the relationship between home cooking and dietary outcomes (e.g., dietary intake) were inconsistent. The inconsistency may be partially explained by various definitions and methods used to assess home cooking. This scoping review aimed to examine the definitions and methods used in studies assessing the relationship between home cooking and dietary outcomes.

Methods: Six databases (4 English: PubMed, Web of Science, Scopus, and ProQuest; 2 Japanese: Ichūshi and CiNii) were used to identify the relevant studies published in English or Japanese. When explanations were available in measurements used to assess home cooking, definitions were identified. Measurements for home cooking were classified based on participants' perceptions, perception-dependent (e.g., self-reported questions), or investigators' classification, perception-independent (e.g., diet records). In addition, indicators used to assess home cooking were extracted. The quality of the analyses was evaluated based on previously developed criteria that were further adapted by including home cooking measurements as a domain.

Results: Of the 40 studies (2 in Japanese) included in this review, 8 provided definitions but did not specify the extent (e.g., the number of dishes) or the level (e.g., the number of prepared ingredients or meals) of convenience foods allowed in home food preparation. Twenty-nine studies used perception-dependent methods, and 11 used perception-independent methods. All but 5 studies used single indicators, primarily the preparation frequency (n=18), to assess home cooking. Studies that used multiple indicators or perception-independent methods had high or moderate overall quality (n=21). In contrast, those using single indicators based on perception-dependent methods had low quality (n=19). The relationships between home cooking and dietary outcomes varied. Inconsistent findings were observed for fruits and vegetables in high- or moderate-quality studies, whereas consistent in low-quality studies. However, for dietary components often regarded as unhealthy (e.g., fast foods, sugar, and saturated fatty acid), consistent negative relationships were observed in high- or moderate-quality studies, whereas inconsistent in the low-quality.

Conclusions: The definitions extracted lacked clarity, and most methods may not capture the complexities of home cooking. Relationships between home cooking and dietary outcomes need to be interpreted cautiously on measurements of home cooking.

Keywords: Home cooking, Dietary intake, Methodology, Dietary assessment

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-12

A re-evaluation of the antioxidant property of vitamin A: Retinol can enhance glutathione levels in cultured monocyte/macrophage cell lines

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Background and objectives: Vitamin A is often referred to as an antioxidative vitamin based on the property of pro-vitamin A carotenoids, such as β-carotene, α-carotene, and β-cryptoxanthin, to quench singlet oxygen efficiently. Unlike pro-vitamin A carotenoids, preformed vitamin A molecules, such as retinol, retinal, and retinoic acid (RA), do not have the significant quenching ability. We previously found that the supplementation of murine macrophage RAW264 culture with β-carotene increased intracellular glutathione (GSH) levels. We also demonstrated that the mRNA and protein expression levels of glutamate-cysteine-ligase [EC 6.3.2.2], the rate-limiting enzyme in GSH synthesis, were increased in RAW264 cells cultured in media supplemented with β-carotene. As GSH is a major intracellular antioxidant, we had estimated that, in addition to the singlet-oxygen quenching activity, promoting GSH synthesis may be another antioxidative ability of β-carotene as a carotenoid. However, we found that retinol also have the same effect (Food Science & Nutrition 6, 1650-1656, 2018), even though retinol is not a carotenoid. On the other hand, we found that the RA signaling pathway, which plays a role in a wide range of transcriptional activities, is not involved in the expression of glutamate-cysteine-ligase by β-carotene, and the supplementation with RA was indeed not as effective as that with retinol. Thus, we hypothesized that retinol is the molecule responsible for enhancing GSH levels in RAW264 cells. To develop this, we assessed the effect of retinol on monocyte/macrophage cell lines other than RAW264.

Methods: We investigated the effect of retinol on intracellular GSH levels using the murine macrophage cell line J774.1 and the human monocyte/macrophage cell line THP-1.

Results: We found that retinol supplementation increased GSH levels in both J774.1 and THP-1 cells in a dose-dependent manner. In contrast, the effect of RA supplementation on enhancing GSH levels was not detected in either cell line.

Conclusions: Our findings suggest that retinol supplementation may increase GSH levels in unspecified monocyte/macrophage cell lines.

Keywords: Retinol, vitamin A, glutathione, Monocyte/Macrophage, antioxidant property

Conflicts of interests: none

PAB(T2)-13

Evaluation of daily salt intake using a new self-monitoring salt excretion device for monitoring salt excretion on urination

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Background and objectives: Sodium excretion measurement in 24-h pooled urine is the gold standard for estimating the dietary salt intake. However, collecting 24-h urine is difficult in daily life. We investigated and estimated the daily salt intake using a new self-monitoring salt excretion device during each urination. This study aimed to assess the validity of the new self-monitoring salt excretion device (new device), by comparing it with the 24-h urine collection method.

Methods: Eleven healthy female students who were studying nutrition participated in this study. The 24-h salt excretion was measured 8 days (two non-consecutive days at a 3-month interval from May 2021 to February 2022). Participants were instructed to urinate in a 500-mL measuring cup of the new device and measure their urinary salt excretion every time voiding the entire day. After each measurement, they poured all the urine from the measuring cup into the proportional sampling cup and collected a 1/50 portion of the 24-h urine. Urinary sodium concentrations were analyzed using the electrode method. The 24-h urinary sodium excretion was converted into its salt equivalent. The study protocol was approved by the ethics committee of Jissen Women's University (approval no. H2021-05).

Results: A total of 87-day measurements were included in the analysis, excluding one day of incomplete urine collection for one participant. The mean (standard deviation) 24-h urinary salt excretions derived from the 24-h urine collections and new device were 7.7±2.8 g and 7.6±2.9 g, respectively. However, no significant difference was observed between the measurement values of the two methods and found a significant positive correlation (r = 0.902; p <; 0.001). Among our participants, those who met the national intake recommendations (<;8.0 g/day) were 4 and 5 from the 24-h urine collection method and new device, respectively.

Conclusions: Despite the limited number of participants, the 24-h urinary salt excretion measured using a new self-monitoring salt excretion device is an efficient assessment method of daily salt intake compared with the 24-h urine collection.

Keywords: nutritional assessment, salt monitoring device, urinary salt excretion

Conflicts of interests: none

PAB (T2)-14
Effect o Covid-10 health services in Guinea: Case of the vitamin a supplementation campaign

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Background and objectives: From July 26 to September 25, 2020, the Ministry of Health, UNICEF and Helen Keller International implemented a vitamin A supplementation (VAS) campaign in Guinea in the 38 health districts in 2 phases first phase from July 26 to August 6, 2020, in 29 districts, and from September 21 to 25, 2020 in 9 districts during the COVID-19 pandemic. Various measures were implemented to reduce the risk of COVID-19 transmission, including the development of a guide to implement VAS; the purchase and distribution of hand sanitizer and face masks; infection prevention training, and close supervision of community distributors. This study assessed the impact of COVID-19 on reported health seeking behavior and VAS coverage.

Methods: This cross-sectional study used data from a post-campaign coverage survey that was administered among caregivers of children aged 6-59 months in 30 of 38 health districts in Guinea from September 10-26, 2020. This survey used a stratified WHO (2015) cluster design. In total, 1,700 caregivers of 2,720 children were surveyed. Interviews were also conducted among 122 health workers and 138 community distributors.

Results: VAS coverage among children was 72% (85% in rural areas and 60% in urban areas). Approximately 96% of households received VAS at home through community distributors. Only 4% of households refused VAS. The main reasons for refusal were fear of contracting COVID-19, and fear of administering the COVID-19 vaccine to children. Nearly 98% of respondents reported willingness to go themselves or send a household member to a health facility for treatment if they suffered from any illness during the COVID-19 pandemic. Among the respondents, 66% reported that community distributors wore masks, 56% reported that community distributors stayed at least one meter away from others, and 60% reported that distributors washed their hands with hand sanitizer before administering vitamin A.

Conclusions: This campaign held in the context of COVID-19 achieved an average VAS coverage of 72%, below the target of 80%. Observed COVID prevention measures were lower than ideal but may be affected by recall bias.

Keywords: Covid 19, Vitamin A Supplementation, Coverage survey

Conflicts of interests: none

PAB (T2) – 15
Fluctuation of Serum 25(OH)D during the Menstrual Cycle in Young Japanese Women

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Background and objectives: There is a growing interest in the importance of vitamin D in gynopathy, female reproductive function, and menstruation. However, the role of vitamin D function in the female reproductive health has not yet been elucidated. Therefore, this study aimed to determine whether serum 25(OH)D levels change during the menstrual cycle of young women.

Methods: The participants included 39 healthy Japanese women aged 20–27 years. The survey period was from October to December 2018. Before the survey, the participants measured their basal body temperature for two months to estimate the follicular, ovulation, and luteal phases of their menstrual cycle. For the ovulation phase, a test kit for the prediction of ovulation day was also used, which made estimates based on the measurement of urinary LH. Blood sampling and sun exposure time surveys were conducted within the follicular, ovulatory, and luteal phases (three times in total), and physical measurements and semi-quantitative food frequency questionnaire were conducted once during the survey period.

Results: Regarding hormonal fluctuations during the menstrual cycle, LH levels were significantly higher in the ovulation phase than in the follicular and luteal phases. FSH levels were significantly lower in the luteal phase than in the follicular and ovulation phases. The estradiol levels were significantly higher in the ovulation and luteal phases than in the follicular phase. Progesterone levels changed significantly across all three phases and were highest in the luteal phase. Serum 25(OH)D also changed; it was significantly lower in the luteal phase (15.8 ± 3.7 ng / mL) than in the follicular (16.9 ± 3.5 ng / mL) and ovulation (16.5 ± 3.3 ng / mL) phases.

Conclusions: The results of this study suggest that serum 25(OH)D levels change during the menstrual cycle of young Japanese women.

Keywords: vitamin D, estradiol, progesterone, menstruation, Japanese Women

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-16

Nutritional assessment of plant-based meat alternatives in Spanish Supermarkets

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Background and Objectives: Since the classification of processed meat as carcinogenic to humans by the IARC (International Agency for Research on Cancer) in 2015, a significant increase of consumption of plant-based (PB) meat alternatives has been observed worldwide. This tendency occurs in an environment characterized by concern for health, animal welfare, as well as greater sensitivity about the emission of greenhouse gasses. In this context, the evidence on its nutritional quality is limited. Therefore, our objective is to evaluate the nutritional quality of PB-meat alternatives available in Spanish Supermarkets.

Methods: An audit undertaken in September 2020 (updated in December 2021) has been conducted from seven of most common Spanish Supermarkets. Quantitative and qualitative information were collected as well as the estimation of Health Star Rating (HSR). For each product, several data were collected: type of product, nutritional content (including: calories, carbohydrates, sugars, proteins, total fats, saturated fats, salt and fiber /100g of product) and main ingredients.

Results: A total of 151 products were analyzed and classified in 9 categories: sausages, nuggets and patties, meatballs, cold-cuts, veggie burgers, "Beyond Meat type" burgers, "chicken-type" strips, mince and seitan. These products were generally low in sugars, but high in carbohydrates, salt, total and saturated fat, as well as dietary fiber compared to meat. The most relevant vegetable protein source was soy protein (45%) followed by wheat gluten (37.75%). On the other hand, 28.48% of products presented animal protein as the main protein source, transforming them into non-vegan products. The main ingredient used in these products was egg, found mostly in the cold-cuts category (44%). These products stand out for the larger list of ingredients and additives. Moreover, a large number of technological processes used in their elaboration, transform them as ultra-processed foods (UPFs).

Conclusions: This study shows that the greater number of plant-based meat alternatives products available in Spanish Supermarkets have a variable nutritional composition depending on the product category. Further research is needed to determine if replacing meat with these UPFs in the population`s diet could be a good solution or an alternative towards healthier and more sustainable dietary patterns.

Keywords: plant-based meat alternatives, nutritional quality, ultra-processed foods

Conflicts of interests: none

PAB(T2)-17

Semi-quantitative dietary assessment among children in Sissili Province, Burkina Faso shows low Vitamin A intake and high consumption of sugar sweetened beverages.

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Background and objective: Few studies using blood tests have reported the prevalence of vitamin A deficiency (VAD) among children in areas of Burkina Faso. No studies have estimated dietary intake of vitamin A (VA) across a wide range of local foods. Study aimed to determine dietary intake of VA among young children in the province of Sissili, Burkina Faso using quantitative dietary recall. Study population: Representative sample of 524 mother-child pairs (children aged 6-23 months) from the province of Sissili in Central-Western Burkina Faso.

Methods: A cross-sectional study was conducted in two phases. Phase one, conducted in June 2020, established a list of 103 locally relevant foods. For mixed recipes, quantities of ingredients and portion sizes were calibrated using local kitchen utensils (spoons, glasses, cups, bowls, plates, etc.) as visual aids. Phase two, in July 2020, consisted of a 24-hour dietary recall of children's intake conducted with their caretakers based on the 103 foods previously listed and calibrated. Intake was estimated using the nutrient profiles of these foods.

Results: The mean daily intake of retinol was 73.1 ± 169.5 µg RE/day and average ß-Carotene intake was 804.2 ± 2018.3 µg/day for the entire population of children. Only 5% of children met the U.S. Institute of Medicine's estimate of adequate intake for VA (500 µg/day retinol activity equivalents for children 6-12 months; 300 µg/day retinol activity equivalents for children 12-23 months). Dark green leafy vegetables contributed the most RE to children's diets. Sixteen percent of children had consumed meat, and 10% had consumed dairy, while 20% consumed a sugar sweetened beverage the previous day. The average dietary diversity score, at 2.8 ± 1.2, was below the 2021 WHO and UNICEF minimum recommended 5 of 8 food groups.

Conclusions: Dietary intake of VA remains below the recommendations. Children are likely at high risk for VAD, while consumption of sweetened beverages is elevated. Micronutrient supplementation strategies remain relevant for this at-risk population. In the context of the nutrition transition, dietary interventions should address under consumption of micronutrient rich foods but also overconsumption of low nutrient and high sugar foods.

Keywords: Dietary intake of vitamin A, Semi-quantitative assessment, Vitamin A deficiency, Mother-child pairs, Burkina Faso

Conflicts of interests: none

PAB(T2)-18

Bioavailability of the indispensable amino acids of the red kidney bean in a typical Jamaican meal using a dual stable isotope tracer method

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Background and objectives: Reliable knowledge of protein and indispensable amino acid (IAA) digestibility is necessary to assess protein quality which is important to inform dietary choices for maintaining good health. More recently the minimally-invasive dual stable isotope tracer (DSIT) method has been shown to reliably measure IAA digestibility at the level of the ileum, compared to the commonly used oro-faecal method which is confounded by endogenous protein sources. This study aimed to evaluate the IAA digestibility, except tryptophan, of the red kidney bean (Phaseolus vulgaris) consumed in a typical Jamaican meal, in adults, using the DSIT method and derive its digestible IAA score (DIAAS).

Methods: IAAs in red kidney beans were intrinsically labelled with deuterium by adding 2H2O in timed pulses to the irrigation water. Uniformly-labelled [13C]-spirulina (reference protein) was added to a meal-mix of labelled stewed beans with rice, and fed to 5 males and 5 female adults (25.5±5.6 years; Normal BMI) as primed/intermittent doses to achieve a steady state IAA enrichment in the plasma [Clinical trial: NCT-04118517]. Enrichment (ppm excess) of the bean 2H-IAA and 13C-IAA in the meal mix as well as their appearance in plasma was measured by mass spectrometry. For each IAA, digestibility was calculated as the ratio of plasma 2H-IAA to meal 2H-IAA divided by the ratio of plasma 13C-IAA to meal 13C-IAA, adjusted for known digestibility of reference protein and a transamination factor.

Results: Adequate 2H enrichment of IAAs in the red kidney beans was achieved (>;1000 ppm excess). Plateau enrichment, indicating a steady state of 2H and 13C, was obtained between 5-8 hours (CV <; 10%). The mean IAA digestibility (%) of red kidney beans was 79.4±0.5, with lysine and threonine having highest (85.7±1.7) and lowest (69.0±1.2) values respectively. DIAAS (%) calculated using the established adult IAA requirement pattern were greater than 75, except for methionine and cysteine, with a score of 37, being the limiting amino acids.

Conclusion: The red kidney bean is a good source of the IAAs (DIAAS >; 75) except sulphur amino acids (SAAs) indicating the importance of complementing beans with cereal-grains in plant-based diets.

Keywords: Red Kidney Beans, Indispensable Amino Acids, Dual Stable Isotope Tracer, DIAAS

Conflicts of interests: none

PAB(T2)-19

A simplified estimation method for the percentage of subjects with inadequate micronutrients intake. -Secondary Analysis of National Health and Nutrition Examination Survey (NHNS) 2017 in Japan-

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Background and objectives: Although overt nutritional deficiencies are rare in developed countries, epidemiological studies have revealed that even micronutrient insufficiencies, milder than deficiencies, are risks of various non-communicable diseases (NCDs). However, publicly available data on micronutrients intake assessment in the Japanese population is limited. In this study, we have studied the possible usefulness of simplified evaluation of inadequate micronutrients intake calculated from the mean and standard deviation (SD) using data from the National Health and Nutrition Examination Survey (NHNS) 2017.

Methods: NHNS 2017 data including 4,464 subjects (Males/Females: 2,072/2,392), aged 18 years and older, excluding pregnant and lactating women, were analyzed with stratification by gender and age (younger; 18-49 years vs, older; 50 years and older) for micronutrients intake status, including calcium, iron, zinc, vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin B12, folic acid, and vitamin C. Percentage of subjects with inadequate nutrients intake was calculated either by the cut-point method using the raw data (reference method) or from the sex- and age-specific mean and SD from NHNS 2017 (simplified method).

Results: In both genders, the percentage of subjects with inadequate micronutrients intakes, as assessed by the reference method, was significantly higher in the younger group than in the older group, except for zinc intakes in males. The difference between values from the two methods was larger in the older groups (13.6%) than in the younger group (approximately 7%). The ranking of nutrients according to the proportion of subjects with inadequate micronutrient intakes was in general agreement with the reference method in both gender and age. Differences were relatively smaller in calcium, vitamin A, and vitamin B1, and larger in iron, vitamin B6, and folic acid.

Conclusions: The results of the simplified method calculated from the mean and SD were not so discordant from those by the raw data-based reference method regarding the percentage of subjects with inadequate nutrient intake, although the differences were greater in the older group, which had larger inter-individual variability in nutrient intakes. Our results showed that a rough estimate can be made with mean and SD alone would be of practical value in assessing the prevalence of inadequate micronutrients intake.

Keywords: Inadequate micronutrients intake, The cut-point method

Conflicts of interests: none

PAB(T2)-20

Association of serum uncarboxylated osteocalcin levels with dietary vitamin K, soy products, and vegetable intake in Japanese female athletes

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Background and Objectives: Bone strength is defined by two main aspects: bone mineral density (BMD) and bone quality. Several studies on the bone strength of athletes have reported that BMD is one of the most important factors for their bone health. However, bone quality, which accounts for approximately 30% of bone strength, has been poorly studied in Japanese female athletes. Serum uncarboxylated osteocalcin (ucOC) levels, an indicator of bone quality, may be linked to nutritional intake. Previous studies have revealed that high serum ucOC levels were associated with low vitamin K intake among elderly people. The current study aimed to understand the association of serum ucOC levels with dietary vitamin K and food group intake in Japanese female athletes.

Methods: Fifty-two female athletes (age 20.0 ± 1.2 years) participated in this study. Their nutritional profile and food group intake were investigated using 3-day dietary records. Food groups were categorized into 18 groups according to the Standard Tables of Food Composition in Japan. Blood samples were collected after overnight fasting to measure serum ucOC levels, while their body composition and BMD were estimated using dual-energy X-ray absorptiometry. Data were analyzed using Spearman's correlation coefficient.

Results: In the present study, the intake level of vitamin K was 235 ± 148 µg/d, and approximately 70% (n=36) of the participants consumed more than the adequate intake (AI) of vitamin K, based on the Dietary Reference Intakes for the Japanese female population. Correlation analysis showed significant negative association of serum ucOC levels with daily intake of vitamin K (r = -0.388, p = 0.004), soybean products (r = -0.326, p = 0.018), and vegetables (r = -0.405, p = 0.003) after adjustment for energy intake.

Conclusions: Our study revealed that serum ucOC levels are associated with dietary vitamin K intake and the consumption of vegetables and soybean products, which are good sources of vitamin K in Japanese diet. Athletes may consume more vitamin K than the general population to maintain bone health, even though most participants in this study consumed more vitamin K than AI.

Keywords: female athletes, bone quality, undercarboxylated osteocalcin, dietary habits, vitamin K intake

Conflicts of interests: none

PAB(T2)-21

A crossover study on the effects of continuous soymilk intake on lipid metabolism and glucose metabolism in Vietnamese (2nd Report) -Lipid metabolism improving effect-

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Background and objectives: Soy protein has been reported to lower serum LDL cholesterol and triglycerides in many meta-analyses. Unprepared soymilk is expected to have a physiological effect due to its high protein content, but there are few clinical trials on soymilk intake in Vietnam and other Asian countries targeting patients with dyslipidemia. Continuing from the first report, this study was conducted a crossover study to verify the effect of unprepared soymilk intake on improving lipid metabolism in a joint study with Vietnam National Institute of Nutrition, Nam Dinh University of Nursing, MARUSAN-AI Co., Ltd., and Kyushu Women's University.

Methods: It was conducted with the approval of the Kyushu Women's University Ethics Review Committee and the Vietnam National Institute of Nutrition Ethics Review Committee. Thirty-seven type 2 diabetic patients with LDL cholesterol borderline (3.10-3.59 mmol/L) or mild (3.60-4.10 mmol/L) dyslipidemia attending hospital in Nam Dinh City, Vietnam, were included in the analysis. The study design was a randomized crossover study of 2 groups, and only the intervention group was given 500 mL/day (250 mL x 2 times) of unadjusted soymilk (MARUSAN-AI Co., Ltd.) for 8 weeks, and the washout period was 4 weeks. The primary endpoints were LDL-C, TG and the secondary endpoints were TC, HDL-C.

Results: The amount of change in LDL-C and TG in the intervention group were significantly reduced at both the 4W-intake and 8W-intake. In addition, the amount of change in HDL-C in the intervention group were significantly increased at the 8W-intake. Furthermore, as a result of stratified analysis, it became clear that the improvement effect of LDL-C was significantly higher in the outer group of reference value than the inner group, and the improvement effect of HDL-C was significantly higher in the outer group. In addition, although no significant change in body weight was observed, the waist circumference and hip circumference of the intervention group decreased significantly the 4W-intake and 8W-intake.

Conclusions: For Vietnamese with type 2 diabetes with dyslipidemia, it became clear that the continuously intake of unprepared soymilk could decrease LDL-C and TG and increase HDL-C.

Keywords: Vietnamese, Unprepared soymilk, LDL cholesterol, Lipid metabolism

Conflicts of interests: This study was funded by MARUSAN-AI Co., Ltd.

PAB(T2)-22

A crossover study on the effects of continuous soymilk intake on lipid metabolism and glucose metabolism in Vietnamese (1st Report) - Nutrient intake status -

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Background and objectives: Lifestyle-related diseases are increasing in Vietnam as in developed countries, and the proportion of people who have died from hyper-LDLemia has increased by 37.3% in 10 years from 2009. The annual per capita consumption of soymilk by Vietnamese is increasing year by year. Soymilk consumed in Vietnam is a high sucrose content, therefore, it could be one of the factors that increase the risk of lifestyle-related diseases. In this study, joint research with Vietnam National Institute of Nutrition, Nam Dinh University of Nursing, MARUSAN-AI Co., Ltd., and Kyushu Women's University, we investigated the effects of unprepared soymilk intake without sucrose on nutrient intake and nutritional status in Vietnamese with type 2 diabetes with dyslipidemia.

Methods: Thirty-seven type 2 diabetic patients with LDL cholesterol borderline (3.10-3.59 mmol/L) or mild (3.60-4.10 mmol/L) dyslipidemia attending hospital in Nam Dinh City, Vietnam, were included in the analysis. The study design was a randomized crossover study of 2 groups, and only the intervention group was given 500 mL/day (250 mL x 2 times) of unprepared soymilk (MARUSAN-AI Co., Ltd.) for 8 weeks, and the washout period was 4 weeks. The test items were a 24-hour recall method and a dietary survey using the nutrition support system (Calorie Smile Vietnam version), and physical measurements (height, weight, body fat percentage), and a total of 6 surveys and measurements were performed once each period.

Results: As a result, the protein intake was significantly higher in the intervention group than in the control group in the Δ4W-intake and the Δ8W-intake. The protein content of unprepared soymilk was 4.5 g/100 mL, so the intervention group significantly increased protein intake by ingesting 500 mL daily. Sugars intake increased significantly in the control group at the Δ8W-intake, but not in the intervention group.

Conclusions: A continuous intake of unprepared soymilk significantly increased protein intake in the intervention group but did not increase sugars intake. In the future, we will investigate the effect of unprepared soymilk intake on nutritional status and verify that it will lead to the prevention of lifestyle-related diseases. [Conflict of Interest Disclosure] This study was funded by MARUSAN-AI Co., Ltd.

Keywords: Vietnamese, Unprepared soymilk, Nutrient intake

Conflicts of interests: none

PAB(T2)-23

Deterioration of nutrition during hospitalization in convalescent rehabilitation ward decreases effects of rehabilitation

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Background and Objectives: As appropriate nutrition management could improve rehabilitation outcomes, malnutrition among patients should be addressed as early as possible. Therefore, we have created malnutrition criteria in our hospital as a nutrition assessment method, to select malnourished patients without an interview. The criteria were composed of 5 items: 1) body mass index <; 18.5 kg/m2, 2) serum albumin ≦ 3.0 g/dL, 3) average intake rate of meal ≦ 50 %, 4) rate per week of weight loss ≧ 1 %, and 5) others (total parenteral nutrition and digestive symptom). When two or more items were satisfied, the patient is considered suffering from malnutrition. In this study, the practicality of the criteria was verified from the viewpoint of rehabilitation outcomes.

Methods: The participants were 65 years or older and hospitalized between February 2020 and November 2021, after acute-phase treatment for brain stroke. Their motor score in Functional Independence Measure (FIM-M), body weight (BW), and nutrition status were evaluated at admission and discharge. They were divided into four groups with our criteria as follows: 1) “Good” (G), not suffering from malnutrition during hospitalization; 2) “Worse” (W), suffering from malnutrition during hospitalization; 3) “Improved” (I), recovered from malnutrition at discharge; and 4) “Deteriorated” (D), increased malnutrition at discharge. During hospitalization, the benefits of FIM-M (amount of FIM-M change), efficiency of FIM-M (benefit of FIM-M divided by the length of hospital stay), and BW change were compared between these four groups.

Results: Of the 142 patients (W:M = 71:71, mean: 77.7-years-old), 97, 20, 14, and 11 were classified in the G, I, D, and W groups, respectively. The benefit and the efficiency of FIM-M in group D were significantly lower than in group G (12.8 vs. 29.3, p=0.012, and 0.17 vs. 0.39, p=0.023, respectively). BW significantly decreased during hospitalization in group D, compared to groups G and I (-5.2 kg vs. -1.6 kg and 0.18 kg, respectively, p<;0.001).

Conclusions: Our original criteria for malnutrition might be helpful in identifying patients whose benefit and efficiency of FIM-M are poor. Furthermore, scheduled BW measurements could be a valuable method to prevent rehabilitation outcomes from worsening.

Keywords: Malnutrition, Nutrition assessment, Convalescent rehabilitation, Functional Independence Measure

Conflicts of interests: none

PAB(T2)-24

Factors affecting Vitamin A Supplementation hesitancy and refusal among families with children under 5 years in two rural communities in East Cameroon

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Background and objectives: High coverage of vitamin A supplementation (VAS) is required to reduce child mortality in countries with high prevalence of vitamin A deficiency. With the support of Helen Keller Intl and UNICEF, a national VAS campaign was organized in Cameroon in November 2021. Community acceptance of vitamin A has traditionally been high. In 2021, the VAS campaign coincided with the COVID-19 vaccination campaign. We took advantage of a mop-up campaign to incorporate a study to understand VAS refusal. The objective of this study is to explore reasons for VAS hesitancy and refusal in two districts in Cameroon in 2021.

Method: The study used a cross-sectional study design with two questionnaires on VAS refusal, one for caregivers of children aged 6-59 months, and another for VAS campaign supervisors. Self-administered surveys were conducted in Batouri and Bertoua, two semi-urban and urban health districts in the Eastern Cameroon. All parents who refused VAS for their children were interviewed on their reasons. VAS campaign supervisors were interviewed on strategies to address the refusals.

Results: Overall, 339 cases of refusal were reported representing 0.5% of the 67,800 children targeted by the campaign. Refusal was higher among caregivers of children aged 6–11-months (66%). The refusal management teams successfully convinced 209 caregivers (62%) to change their mind and accept VAS. Main reasons for refusals included fear that the campaign was a pretext to administer COVID-19 vaccines (31%) and that the capsule would make the child sick (17%). Some caregivers reported that they preferred to get VAS from a health facility (11%). Other reasons for refusal included caregiver suspicion about a free health intervention (5%), perception it was not needed as their child was not sick (4%), or the belief that VAS would make their child sterile (3%). Some caregivers (11%) did not provide a reason. Among the 24 supervisors interviewed reasons for the high levels of refusal, the vast majority cited weakness in the social mobilization before the campaign.

Conclusion: The COVID-19 vaccination campaign was launched in Cameroon two weeks before the VAS campaign in November 2021. The COVID-19 vaccination was largely rejected by the Cameroonian population. Caregiver fear of the COVID-19 vaccine influenced their refusal of the VAS campaign. Stronger social mobilization and mass communication are needed to sensitize caregivers on the benefits and safety of VAS and Covid-19 vaccines.

Keywords: Refusal, Vitamin A, Supplementation, Covid-19, VAS Campaign

Conflicts of interests: none

PAB(T2)-25

An algorithm to assess calcium bioavailability from foods

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Background and objectives: Calcium bioavailability from individual foods, beverages, and fortified foods has been determined with calcium isotopic tracers and compared to milk as a referent to adjust for physiological differences of the host. Our objective was to develop a calcium bioavailability algorithm using these data to predict calcium bioavailability in the food supply.

Methods: We modeled data from 475 observations to develop a predictive algorithm for calcium bioavailability in adults based on calcium load and oxalate and phytate loads which represent the two main inhibitors of calcium absorption.

Results: The calcium bioavailability model was optimized by minimizing the squared residuals between observed data and model-calculated values using the least-squares fitting routine in WinSAAM software. Model development affirmed the effect of calcium load on fractional calcium absorption and the potency of oxalate as an inhibitor of calcium absorption compared to phytate.

Conclusions: This algorithm will be helpful in assessing calcium availability from the food supply and for designing policies and interventions to address inadequate calcium intake for populations. It will also be useful for developing diets for individuals, research cohorts, and populations. We plan to work with an international network of scientists to apply this algorithm to countries in South Asia and Africa as test cases.

Keywords: calcium, bioavailability, algorithm, food

Conflicts of interests: none

PAB(T2)-26

Triglyceride to high-density lipoprotein cholesterol ratio predicts body fat percentage rather than the skeletal mass index in elderly patients with diabetes mellitus.

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Background and Objectives: The triglyceride/HDL-cholesterol ratio (TG/HDLc) is significantly correlated with HOMA-R, a marker of insulin resistance. Furthermore, TG/HDLc has also been reported to be an independent marker of cardiovascular risk in obese patients. Whether TG/HDLc can be a good marker of body composition remains unclear, although decreased skeletal mass and increased body fat accumulation can lead to insulin resistance.

Methods: The subjects (>;60 years old) with diabetes mellitus were enrolled at Fujita Health University and had blood HbA1c and eGFR data and body composition results obtained from their medical records. After adjusting for age, sex, HbA1c, eGFR, and BMI (body fat percentage and SMI only), we evaluated the nonlinear association between TG/HDLc and BMI, skeletal muscle index, and body fat percentage. Furthermore, TG/HDL≧3 is known as a high-risk condition for cardiovascular disease. After dividing the subjects into high-risk (TG/HDL≧3, n=88) and low-risk (TG/HDL<;3, n=213) groups for cardiovascular disease, we examined factors contributing to the high-risk group. This study was conducted with the approval of the Fujita Health University Ethics Committee.

Results: A total of 301 subjects (164 males and 137 females) were included in this study. In nonlinear multivariate regression analysis, BMI was correlated with TG/HDLc (β=1.63, 95% CI 0.82-2.43; p<;0.001). Body fat percentage also correlated with TG/HDLc (β=2.078, 95% CI 1.047-3.11; p<;0.001), sex (β=5.90, 95% CI 4.81-6.99; p<;0.001) and BMI (β=8.22, 95% CI 7.51-8.92; p<;0.001). In contrast, SMI was significantly correlated with age, sex, and BMI but not TG/HDLc. Linearity between TG/HDLc and BMI or body fat percentage was found up to approximately 3 for TG/HDLc, 24.5 for BMI, and 27.5 for body fat percentage. Finally, logistic multivariate analysis showed that sex (odds ratio 0.42; 95% CI 0.17-0.99; p=0.049), eGFR (odds ratio 0.98; 95% CI 0.97-0.99; p=0.012) and body fat percentage (odds ratio 1.09; 95% CI 1.047-1.13; p<;0. 001) were associated with high cardiovascular risk (TG/HDL≧3).

Conclusions: In nonobese patients with diabetes mellitus, TG/HDLc is a good marker of body weight and body fat percentage. This study also confirms that men, renal dysfunction, and high body fat percentage may contribute to high cardiovascular risk.

Keywords: body fat percentage, skeletal muscle index, diabetes mellitus, Triglyceride, high-density lipoprotein cholesterol

Conflicts of interests: none

PAB(T2)-27

Assessing nutrient content of locally available commercially produced complementary food products in the Philippines using WHO Europe's Nutrient Profile Model

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Background and objectives: About five in every 10 young children in the Philippines consumed commercially produced complementary food (CPCF) products in a national survey conducted in 2019. Sales of these products have gradually increased in the last five years. We aimed to assess the suitability of available CPCF in the Philippines targeted to children aged 6 to 36 months in terms of nutritional content.

Methods: Commercially produced complementary food products available in the National Capital Region of the Philippines were assessed using the 2019 World Health Organization Europe Region Nutrient Profile Model (WHO NPM) for CPCF. The model proposed compositional thresholds on the following key nutrients: total energy, total sugar, total fat, and sodium, among others. Products found to be locally available, whether from physical or online stores, from August 01 to 28, 2020 were included in the assessment. Product composition was ascertained based on the nutritional information on the product package.

Results: A total of 211 locally available CPCFs, the majority (98%) of which were imported, were assessed. About 37% met the WHO NPM for CPCF requirements for total energy, total sugar, total fat, and sodium levels. Among the CPCF assessed, 69% did not have added sweetening agents; 98% were below the maximum allowable total fat content, and; 78% met the allowable content for sodium. Sugar contributed between 10% to as high as 67% of the total energy content of CPCF. Aside from confectionery and sweet spreads, products with pureed or dried fruits or fruit juice as one of their ingredients have high sugar content.

Conclusions: The majority of locally available CPCF products in the Philippines were of suboptimal nutrient quality. Manufacturers are urged to reformulate their CPCF products to improve their nutritional content in line with public health guidance. Further, the use of fruits, and other sweetening agents, as an ingredient in CPCF products should be limited. The use of the WHO NPM for CPCF to assess the nutritional quality of locally available CPCF is recommended in lieu of the lack of localized NPM models to assess these products. The development of locally adapted NPM for CPCF is encouraged.

Keywords: commercially produced complementary foods, young children, Nutrient Profile Model

Conflicts of interests: We acknowledge Access to Nutrition Initiative (ATNI) for the technical and financial support in the conduct of this study.

PAB(T2)-28

Effect of lunch with different calorie and nutrient balances on dinner-induced postprandial blood glucose variability

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Background and objectives: Few studies have examined the effects of missing lunch or differences in nutritional balance on blood glucose fluctuations. Therefore, the purpose of this study was to examine the effects of differences in lunch energy (Study1) and nutritional balance (Study2) on postprandial glycemic variability due to dinner.

Method: [Study1] Effects of different amounts of energy at lunch on blood glucose fluctuations. Four trials [No lunch, Low energy (200kcal), Standard (700kcal) and High (1200 kcal) energy] were conducted within the 2-week study period. The energy balance of lunch for each trial (P: 18.5%, F: 33.6%, C: 48.0%) was matched and subjects were 13 healthy men and women (male: 22.4 ± 0.7 years, n=10; female: 21.7 ± 0.3 years, n=3) [Study2] Effect of different nutritional balance at lunch on glycemic variability. Four trials (Standard, High protein(65.1%P), High fat(67.6%F), High carbohydrate(75.1%C)) were conducted within the study period of 2 weeks. Lunch energy for each trial was aligned to approximately 700 kcal, and subjects were healthy men and women (male: 24.6 ± 2.1 years, n=8; female: 23.8 ± 2.1 years, n=6). Trials were conducted at least one day apart, with breakfast-lunch and lunch-dinner intervals of at least 4 hours. Continuous Glucose Monitoring (CGM) was also used to assess blood glucose fluctuations.

Result: [Study1] The area under the curve (AUC) of blood glucose levels after dinner was significantly higher in the no-lunch and low energy trials when compared to the high energy trial (P <; 0.05). [Study2] The AUC of blood glucose levels after dinner was significantly higher in the high-fat trials in comparison with high protein trial (P <; 0.05) or high carbohydrate trial (P = 0.063). There was no correlation between blood glucose fluctuations and meal intervals of lunch/dinner, except for the low energy trial (r = 0.550, P = 0.052).

Conclusions: It was suggested that fasting and low energy diet or high fat diet intake at lunch may increase postprandial blood glucose levels after dinner.

Keywords: postprandial blood glucose, energy of lunch, nutrients balance of lunch

Conflicts of interests: none

PAB(T2)-29

The Price of Good Health: Save the Children leverages a Cost of the Diet to Support the Implementation Nutrition intervention in Mali

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Background and objectives: The USAID-funded Albarka Activity managed by Save the Children aims to improve the health and nutrition of poor and very poor households and IYCF practices in North and Central Mali. A study was conducted to estimate households' minimum cost of a diet [CotD] based on habit and nutritive requirements. The results were used to model the impact of various interventions and identify the ones with highest impact on sustainable nutrition outcomes.

Methods: Albarka used mixed research methods [FDG, food frequency questionnaire, and market surveys] in two livelihood zones and surveyed six markets and six villages per zone. Albarka compiled a list of 106 foods and collected price and weight data in each market. Data on dietary habits including food taboos, perceptions on malnutrition, foods considered as acceptable and non-acceptable, were collected through FDG with PLW and mothers and fathers of children of under two.

Results: The cost of a nutritious diet based on eating habits for Very Poor and Poor households represents 1.5 and 2 times the cost of a diet based solely on energy needs in Timbuktu and Gao regions. The CotD found that low-cost nutritious foods are available in markets year-round as well as foods households gather in the wild at no cost. Lack of income is therefore the main barrier to a nutritious diet, and Albarka can leverage cash transfers and SBC programming to improve nutrition outcomes sustainably. A cash transfer of 42,000 CFA/month for a very poor household could cover the total cost of a food habits nutritious diet for children under two, adolescent girls, and PLW. Identified wild foods such as roselle, water lily, jujube and dates reduce the cost of the diet for lactating women.

Conclusions: The cost of a nutritionally adequate diet adapted to eating habits remains an obstacle for very poor and poor households. Community nutrition groups can support behavior change by promoting and negotiating for the adoption of recommended IYCF behaviors while also teaching caregivers how to create nutrient-rich recipes using cash transfers, leveraging locally available wild foods and eventually using their own income after transfers have finished.

Keywords: Diet, Cost, Nutrition Habits , Women, SBC

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-30

Vitamin D and calcium supplementation in nursing homes - a targeted adherence-improvement intervention study

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Background and objectives: Despite recommendations of supplementation with vitamin D or combinations of vitamin D and calcium to nursing home residents in a variety of countries, vitamin D deficiency is still widespread in this vulnerable group. We recently showed a low adherence to the national recommendation of providing nursing home residents a daily supplement of 20 µg vitamin D and 800-1000 mg calcium. A main barrier for following the recommendation was an ambiguity of responsibility between general practitioners and nursing home staff. The objective of this study was to improve adherence to the vitamin D and calcium supplement recommendation at Danish nursing homes targeting the experienced barriers.

Methods: This was a 20-week targeted adherence-improvement intervention study conducted at two nursing homes. Inclusion criteria was an estimated initial adherence to the recommendation of <; 40 % of residents receiving both supplements. The Plan-Do-Study-act cycle (PDSA) was used as quality improvement method. An information sheet with brief and concise facts on the recommendation and its rationale was developed for the nurses to help them argue for supplementation among the residents and the general practitioners (PDSA cycle 1). Additionally, it was incorporated as part of the initial meeting with new residents that staff encouraged them to initiate supplementation (PDSA cycle 2). Percentage of residents prescribed adequate doses of vitamin D and calcium (≧ 20 µg vitamin D and ≧ 800 mg calcium) was evaluated by patient record reviews every third week during the intervention period.

Results: The two nursing homes had 109 residents. At baseline, 32.1 % (n = 35) of the residents were prescribed adequate doses of vitamin D and calcium. During the intervention period, this increased to 57.8 % (n = 63) at week 10 and to 65.1 % (n = 71) at endpoint in week 20.

Conclusions: We found that involvement of the nursing home staff and targeting experienced barriers improved adherence to the vitamin D and calcium supplement recommendation with a doubling of number of prescriptions of adequate doses of vitamin D and calcium over a 20-week period. Other strategies should be considered to improve adherence even further.

Keywords: Vitamin D, Calcium, Supplementation, Nursing homes, Adherence

Conflicts of interests: none

PAB(T2)-31

Use of generic meal images to assess dietary intakes

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Background and Objectives: Data input required for food-based methods of dietary assessment is time consuming. Individuals who track their intakes value ease of use and convenience. A meal-based approach may reduce the burden of data input and improve adherence to dietary assessment. Methods used in meal pattern research can characterise commonly consumed meals (generic meals) in given populations. The objective of this study was to determine the accuracy of generic meals for dietary intake assessment.

Methods: Generic meals were identified from the 2008-2010 Irish National Adult Nutrition Survey (NANS) using partitioning around the medoids clustering to categorise meals into groups based on similarities in their nutrient profile and food group composition. The nutrient content for each generic meal was defined as the mean nutrient content of the grouped meals. The median weight in each septile of the grouped meals were defined as the 7 standard portion sizes for that generic meal. Following derivation of the generic meals, standardised photographs were taken of the generic meals and 3 of their 7 portion sizes. The photographs were presented to participants who chose the meal images and portion sizes that most represented their dietary intakes in the preceding 24hours. Participants also completed a traditional web-based 24-h recall. Participants completed these in a randomised order. Estimates of nutrient intake arising from the meal-based method and the 24-h recall were compared using t-tests with Bonferroni adjustment. Effect sizes were calculated for the differences.

Results: The 27,336 meals consumed by the 1500 participants in NANS were aggregated to 63 generic meals. 18 participants completed the meal-based and 24-h recall methods of dietary assessment. No significant differences were observed for any of the 4 nutrients compared and all effect sizes were negligible: energy (kcal/day) (P = 0.510, Cohen's d = 0.159), protein (g/day) (P = 0.835, Cohen's d =0.050), carbohydrate (g/day) (P = 0.127, Cohen's d = 0.127), and fat (g/day) (P = 0.957, Cohen's d = 0.013).

Conclusions: Use of meal images provided accurate estimates of mean nutrient intakes. Further work is required in a larger sample comparing a greater range of nutrients and to determine this method's accuracy in classifying individuals according to nutrient-based guidelines.

Keywords: dietary intake assessment, meal patterns, clustering, meal images

Conflicts of interests: none

PAB(T2)-32

Vitamin E intake and status of adolescent girls in central Mozambique – focus on seasonal variation and lactating girls

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Background and objectives: Data on vitamin E (alpha-tocopherol, α-TF) intake and status in low-income populations is scarce. In addition to the antioxidant effects of vitamin E, it is also likely to have specific roles in pregnancy. Our aim was to describe the α-TF intake and status of adolescent girls in central Mozambique and to explore predictors of α-TF status.

Methods: A cross-sectional study was carried out among girls aged 14 to 19 years in Quelimane city (urban area) and two rural districts in January-February and May-June 2010. Dietary intake of α-TF was calculated from 24-h dietary recall data. Non-fasting serum α-TF concentrations were analysed by HPLC, and concentration <;12 µmol/l was used as the cut-off for inadequate status. α-TF:cholesterol ratios were also calculated. Urine tests and background questionnaire were used to determine pregnancy and lactation status. For pairwise comparisons, t-tests and Mann-Whitney U-tests were used. Linear multilevel regression analysis was used to evaluate the associations between independent variables (age, pregnancy, lactation, season) and serum α-TF:cholesterol ratio.

Results: Serum concentration data were available from 508 girls (32% and 68% from urban and rural areas, respectively) and of them, 54 (10.6%) girls were pregnant and 48 (9.4%) lactating. Median (IQR) α-TF intake was significantly (p<;0.001) higher in January-February than in May-June [7.9 (4.9-13.0) and 5.2 (3.0-8.6) mg/d, respectively]. Seasonal differences (p<;0.001) in the same direction were found for serum α-TF concentrations [mean (SE): 14.7 (0.23) vs. 12.0 (0.22) µmol/l] and α-TF:cholesterol ratio [4.10 (0.06) vs. 3.44 (0.07) µmol/mmol, in January-February vs. May-June, respectively]. In January-February, the main sources of α-TF were mango (46%) and dark green leafy vegetables (27%) while in May-June, the main sources were dark green leafy vegetables (38%), groundnuts (17%), and oils (16%). The overall weighed prevalence of vitamin E inadequacy was 36.7% (95% CI: 31.9-42.0%). Season and lactation status were significant predictors of α-TF:cholesterol ratio (lower in lactating girls and in May-June).

Conclusions: Seasonal differences were large and low α-TF serum concentrations prevalent in the population. Lactating adolescent mothers may be a specifically vulnerable group for vitamin E inadequacy.

Further Collaborators: Marja Mutanen Department of Food and Nutrition, University of Helsinki, FinlandLourdes Fidalgo, Kerry Selvester and Carina Ismael from the Food Security and Nutrition Association (ANSA, Maputo, Mozambique Gerorg Alfthan, Department of Chronic Disease Prevention, National Institute for Health and Welfare (THL), Helsinki, Finland

Keywords: vitamin E, adolescent girl, seasonal variation, lactation, Sub-Saharan Africa

Conflicts of interests: none

PAB(T2)-33

Determination of problem nutrients and formulation of food-based recommendations for women and pre-school children in Sri Lanka using Optifood linear programming approach

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Background and objectives: Women and pre-school children in Sri Lanka are at high risk of inadequate intakes of multiple micronutrients. Understanding the deficient nutrients in the current diet are important in recommending food-based dietary guidelines. The objective of the study was to determine the "the problem nutrients" (local food supply is unlikely to provide in sufficient quality) in the diets of women and pre-school children and to formulae realistic food-based recommendations (FBRs) to optimize the nutrient intake using locally available foods.

Methods: Food consumption patterns of 1000 nationally representative sample of 2–5-year-old child and mother (women) pairs were assessed using 24h dietary recalls. By using Optifood linear programming analysis, "problem nutrients" were identified, FBRs were formulated using locally consumed foods and alternative strategies were modelled for the target groups.

Results: Dietary patterns of the women showed that calcium, thiamin, riboflavin, niacin, folate, vitamin A and iron were "absolute problem nutrients" (<;100% of RNI even when the diets are optimized), whereas niacin and vitamin A were "absolute problem nutrients" for pre-school children. Refined grains and products, milk, cooked beans and lentils, fish and eggs were identified as potential nutrient-dense food items that would fill the nutrient gaps. Adherence to the best combination of five food groups and six food subgroups recommendations would ensure the nutrient adequacy (>;65% RNI in the worst-case scenario) of women for protein, fat, vitamin C, vitamin B6, vitamin B12, and zinc and achieving >;40% of RNI for ten modelled micronutrients except for iron. Further, the best combination of seven food groups and five food subgroups recommendations would ensure the nutrient adequacy of pre-school children for protein, fat, thiamin, riboflavin, vitamin B6, folate, and vitamin B12 and achieving >;40% of RNI for ten micronutrients except for vitamin C.

Conclusions: Promotion of the two formulated sets of FBRs only by using locally available foods would not adequately address micronutrient inadequacies of women and pre-school children. Therefore, multiple micronutrient supplementation, food fortification, and targeted nutrition intervention programmes to increase the nutrient-dense foods should be prioritized in order to achieve adequate levels of micronutrients of the pre-school children and mothers.

Further Collaborators: Dr Umi Fahmida and her team of South East Asian Ministers of Education Organization Regional Centre for Food and Nutrition (SEAMEO-RECFON) supported providing training on the Optifood Linear Programming; Nutrition Society of Sri Lanka and Food & Agriculture Organization of United Nations funded the work.

Keywords: Food-based recommendations, Optifood linear programming, Problem nutrients, Pre-school children, Women

Conflicts of interests: none

PAB(T2)-34

Women in Punjab, India have low dietary intakes of iron, zinc, folate, and vitamin B12 and a high prevalence of micronutrient deficiencies: Implications for a trial of multiply-fortified salt

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Background and objectives: We assessed biomarkers of micronutrient (MN) status and dietary intakes among 100 non-pregnant women of reproductive age (NPWRA) in 11 communities of Punjab, India, to determine optimal levels of iron, zinc, vitamin B12, and folic acid to include in multiply-fortified salt (MFS) that will be evaluated in an upcoming trial in this area.

Methods: Fasting venous blood samples were analyzed for hemoglobin (Hb) and biomarkers of iron, zinc, vitamin B12, and folate status. One-day weighed food records were obtained from 100 NPWRA and repeated in 40, to measure usual intakes of iron, zinc, vitamin B12, folate, and discretionary salt. SIMPLE macro was used to estimate inadequate and excessive MN intakes from the baseline diet and model the optimal level of fortificants in MFS to reduce the prevalence of inadequate intakes while limiting intakes above the UL, based on Indian and US IOM Nutrient Reference Values (NRVs).

Results: The prevalence of anemia (Hb <; 12 g/dL) was 37% and of other conditions was as follows: iron deficiency (inflammation-adjusted serum ferritin <; 15 µg/L): 67%; zinc deficiency (plasma zinc <; 70 ug/dL): 34%; vitamin B12 deficiency (serum vitamin B12 <; 150 pmol/L): 23%; and folate insufficiency (RBC folate <; 748 nmol/L): 70%. There was a high prevalence of inadequate MN intakes regardless of which set of NRVs was considered. According to the Indian NRVs, the prevalences of inadequate intakes from the baseline diet were 46% for iron, 95% for zinc, 83% for vitamin B12, and 36% for folate. Mean ± SD intake of discretionary salt was 4.6 ± 1.8 g. Optimal amounts of each MN per gram of MFS were 1.34 mg iron, 1.4 mg zinc, 0.6 µg vitamin B12, and 52.4 µg folic acid. At these levels, the prevalences of inadequate intakes are expected to decline by 29 percentage points (pp) for iron; 76 pp for zinc, 81 pp for vitamin B12, and 36 pp for folate according to Indian NRVs.

Conclusions: MFS holds great potential for substantially reducing this burden of MN deficiencies among NPRWA in the study communities without imposing an unacceptable risk of excessive intakes.

Keywords: Multiply-fortified salt, Micronutrient status, Dietary intake, India

Conflicts of interests: none

PAB(T2)-35

Hepatic Vitamin A Levels from Postmortem Liver Samples from the Child Health and Morality Prevention Surveillance (CHAMPS) Network

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Background: The Child Health and Mortality Prevention Surveillance (CHAMPS) Network aims to elucidate the causes of under-5 mortality in sub-Saharan African and South Asia through minimally invasive tissue sampling (MITS). We investigated the potential of postmortem liver biopsies collected through MITS for reference-standard vitamin A (VA) assessment in two CHAMPS sites.

Methods: Liver samples (n=405, 19 ± 8 mg) were procured via needle biopsy, within 72 hours after death, from stillbirths and cadavers under 5 years of age. Liver VA concentrations (retinol plus retinyl esters) were quantified using ultra-performance liquid chromatography. Cutoffs of <;0.1 µmol/g, >;=0.1 to <;0.7 µmol/g, >;=0.7 to <;1.0 µmol/g, and >;=1.0 µmol/g were used to define VA deficiency (VAD), adequate VA status, high VA status, and hypervitaminosis, respectively. Prior to specimen collection, the MITS procedure involves collection of anthropometric measures, which were used to assess stunting, wasting, and underweight. We used ANOVA to test for differences in the continuous distribution of liver VA concentrations by covariates. Logistic regression was used to model the association between stunting and VAD.

Results: Of the liver samples procured, 368 (90.9%) had viable extraction efficiencies; of which 190 (51.6%) were from Kenya and 178 (48.3%) were from South Africa. The majority (42.1%) were neonates (death in the first 24 hours to 27 days) and 11.1%, 23.4%, 23.4%, were stillbirths, infants (28 days to <;12 months), and children (12-59 months), respectively. The distribution of VA spanned the continuum; 34.0% with VAD, 50.8% with adequate VA status, 6.0% with high VA, and 9.2% with hypervitaminosis. The distribution of Liver VA concentrations differed significantly by age and stunting but not by site, sex, wasting, nor underweight. After adjusting for site, sex, and age,

the odds of VAD were 3-times greater among those who were stunted than those who were not stunted (aOR=3.0; 95%CI (1.8,5.2)).

Conclusions: The VA status in stillbirths and cadavers under 5 years spanned the continuum from deficiency to excess. The odds of VAD were higher among those who were stunted.

Further Collaborators: Cynthia Whitney

Keywords: Undernutrition, Nutrients, Vitamin A, Under-5-mortality, Vitamins

Conflicts of interests: none

PAB(T2)-36

Prevalence of undernutrition among children 1-59 months in the Child Health and Mortality Prevention Surveillance (CHAMPS) Network

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Background: Undernutrition is a key determinant of under-5-mortality (U5M). However, current studies lack high-quality anthropometry on young children and lack comprehensive cause of death data from the highest-burden countries. The Child Health and Mortality Prevention Surveillance (CHAMPS) network assesses causes of stillbirths and U5M in sub-Saharan Africa and South Asia through standardized postmortem anthropometrics as part of the minimally invasive tissue sampling (MITS) procedure. We characterized the prevalence of undernutrition across CHAMPS sites prior to undertaking an analysis of the association between nutritional status and immediate cause of death as determined by CHAMPS adjudication panels.

Methods: We analyzed data from children 1-59 months (mo) who had MITS and cause of death determined between December 2016-March 2022 from all CHAMPS sites, including Bangladesh, Ethiopia, Kenya, Mali, Mozambique, Sierra Leone, and South Africa. Moderate-to-severe undernutrition was defined as wasting, stunting, or underweight, using z-scores <;-2 SD for weight-for-length (WLZ), length-for-age (LAZ), and weight-for-age (WAZ), derived from World Health Organization growth standards. Any undernutrition was defined as WLZ, LAZ, or WAZ<;-2. We expanded the cutoffs of biologically plausible values (>;=-10 SD) to complement this population of severely ill children and took into consideration evidence of undernutrition elsewhere in the data (clinical abstraction, verbal autopsy or photographs).

Results: MITS was performed on 1128 children 1-59 mo enrolled in CHAMPS; 52.2% were aged 1-11 mo, 24.4% were 12-23 mo, and 23.4% were 24-59 mo. Based on postmortem anthropometrics, 72% of cases had evidence of any undernutrition. The prevalence of moderate-to-severe wasting, stunting, and underweight was 51.3%, 38.8%, and 58.8%, respectively. Age-specific prevalence of moderate-to severe malnutrition among children 1-11 mo, 12-24 mo, and 24-59 mo. was 55.4%, 25.9%, 18.7% (WLZ), 52.3%, 26.9%, 20.8% (LAZ), and 57.5%, 24.1%, 18.4% (WAZ), respectively.

Conclusions: Nearly 3 in 4 children 1-59 mo who underwent MITS in the CHAMPS network sites have anthropometric evidence of undernutrition. The increased specificity of diagnoses determined through the CHAMPS adjudication process in conjunction with standardized postmortem anthropometry will allow us to develop robust estimates of cause-specific prevalence of malnutrition.

Further Collaborators: Cynthia Whitney, Parminder S. Suchdev, Milagritos D. Tapia, Adama Mamby Keita, Diakaridia Sidibe, Shabir A. Madhi

Keywords: Undernutrition, Under-5-Mortality, Wasting, Stunting, Underweight

Conflicts of interests: none

PAB(T2)-37

Beverage quality index (BQI): A new tool for the assessment of healthy beverage intake patterns in epidemiological studies

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Background and objectives: Individual beverage recommendations exist, but few studies have assessed overall beverage intake quality. We set up a scoring system for the overall quality of an individual's beverage intake, which may be used in epidemiological studies.

Methods: We used data of 4365 post-myocardial infarction patients (79% male, mean age 69 years) of the Alpha Omega Cohort in the Netherlands. The intake of foods and beverages was assessed using a validated 203-item food frequency questionnaire. We constructed a beverage quality index (BQI), based on recommended intakes for coffee, tea, fruit and vegetable juice, milk, sugar-sweetened beverages (SSB), and alcohol (total ethanol). For each BQI component, patients received a score between zero (no adherence) to 10 (maximal adherence). Additional scoring took place for added sugar and

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

calories in beverages. BQIs could range from zero to 80, with higher scores indicating a healthier beverage intake pattern. Mean BQIs were compared between men and women, between obese (24% of cohort) and non-obese, and between patients with (20% of cohort) and without diabetes, using ANCOVA with adjustment for age and sex (if not used as stratification factor).

Results: Popular beverages were coffee (96% consumers; median of 375 g/d in cohort), tea (74%, 150 g/d), milk (81%; 150 g/d) and alcohol (78%; 74 g/d). Fruit and vegetable juices were less consumed (75%, 54 g/d), as were SSB (69%; 42 g/d). The BQI ranged from 7.7 to 79.2 with a mean (SD) of 47.7 (12.5). Significant differences were found between men and women (mean(SD) BQI: 46.8 (12.5) vs 51.2 (11.9), respectively, p<;0.001). Women had more favorable scores for the components SSB, alcohol, added sugars and energy from beverages than men (all p-values <;0.001). BQI also differed between obese and non-obese individuals [48.7(12.6) vs 47.4(12.4), respectively, p<;0.05], and between patients with and without diabetes [50.4(12.7) vs 47.0(12.3), respectively, p<;0.001].

Conclusions: The BQI may be a valuable tool for the assessment of overall beverage intake quality. Validation of the BQI in non-Dutch and healthy populations is needed. Whether BQI is related to morbidity and/or mortality risk warrants further investigation in epidemiological studies.

Further Collaborators: The Authors declare no further collaborators.

Keywords: scoring system, beverage intake quality, Alpha Omega Cohort

Conflicts of interests: none

PAB(T2)-38

Validity of the Food Frequency Questionnaire-and the 12-day weighed food records-estimated intakes of sodium, potassium, and sodium-to-potassium ratio for screening in Japanese adults

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Background: The use of FFQs is in demand to compare dietary references; however, to date, FFQs have been widely used for ranking individuals in a population based on their dietary intake. Objective: To determine the validity of intake of sodium (salt equivalent), potassium, and sodium-to-potassium ratio (Na/K) obtained using the FFQ to detect individuals who deviated from the dietary reference intakes measured by multiple 24-hour (24-h) urinary excretion in comparison with those using the 12-day weighed food records (12-d WFR).

Methods: The study was conducted among the 235 residents of 40–74 years in five areas designated in the JPHC-NEXT Protocol Validation Study. Correlation coefficients (CCs) of the estimates from the FFQ consisting of 172 items compared with the intakes by 12-d WFR or five-times' 24-h urine excretion was calculated. Using 12-d WFR or 24-h urinary excretion as the reference standards, estimations were also analyzed using the area under the receiver-operating characteristic curve (AUC) at a point of dietary reference intakes.

Results: The CCs of the estimates by the FFQ compared with those by the 12-d WFR were mostly moderate (0.24–0.54), although the CCs compared with those by the 24-h urinary excretion were low or moderate (0.26–0.38). While, the CCs of the estimates by 12-d WFR compared with those by the 24-h urinary excretion were moderate or more (0.52–0.87). AUC values for the intakes by 12-d WFR were >;0.78 using the 24-h urine excretion as a reference standard. AUC values for salt or potassium intakes by FFQ were >;0.7 using the 12-d WFR as a reference standard, but those were ranged from 0.60–0.76, when using 24-h urine as the standards.

Conclusion: The estimation of salt equivalent and potassium intake using the FFQ to screen at a point of absolute intake may be comparable with that using the WFR, but the accuracy was not as good as compared with 24-h urinary excretion. Considerable careful attention is needed when using estimation by FFQ as an absolute intake to screen the individuals. This study was conducted on behalf of the JPHC-NEXT Protocol Validation Study Group.

Further Collaborators: Kazutoshi Nakamura (Niigata University Graduate School of Medical and Dental Sciences)Junta Tanaka (Niigata University Graduate School of Medical and Dental Sciences)Kazumasa Yamagishi (University of Tsukuba, Ibaraki Western Medical Center) Taiki Yamaji (National Cancer Center Institute for Cancer Control)Hiroyasu Iso (Graduate School of Medicine, Osaka University)

Keywords: FFQ, screening, sodium, ROC, validity

Conflicts of interests: This work was funded by a grant from the MAFF (Ministry of Agriculture, Forestry, and Fisheries) Commissioned project study on “Project for the realization of foods and dietary habits to extend healthy life expectancy” Grant Number JPJ009842, the National Cancer Center Research and Development Fund (2011–), and the Funds for Integrated Promotion of a Social System Reform and Research and Development by the Ministry of Education, Culture, Sports, Science, and Technology of Japan (2011–2013).

PAB(T2)-39

Comparison of two methods for measuring consumption of unhealthy sweet and salty/fried foods among young children in Cambodia

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Background and objectives: In 2021, the World Health Organization (WHO) published updated indicators for assessing infant and young child feeding practices, including a new indicator of unhealthy food consumption. This indicator is comprised of two questions assessing 6-23 month-olds' consumption of sweet or salty/fried foods in the previous day. Such an indicator will allow measurement of shifting diet patterns indicative of increased intakes of added sugars, unhealthy fats, and salt among children. Two methods for collecting consumption data have been suggested by WHO – an open-recall 24-hour dietary recall (24HR) or a list-based 24HR. This study compared caregiver responses to these two methods for measuring consumption of unhealthy sweet and salty/fried foods.

Methods: Data were drawn from a survey among a representative sample of 501 children 15-19 months of age in rural/peri-urban Kandal province, Cambodia. Caregivers participated in an open-recall 24HR to identify all foods/beverages consumed by their child in the previous day. Half of the sample was randomly sampled (n=250) to also receive the WHO indicator questions as an abridged list-based 24HR; these caregivers were directly asked about their child's consumption of 1) sweet and 2) salty/fried foods in the previous day. Responses to the open-recall versus list-based 24HR were compared using Cohen's kappa.

Results: Among the 250 caregivers who were asked the list-based WHO indicator questions, 61.6% and 58.8% reported that their child consumed a sweet or a salty/fried food, respectively, as compared to 60.0% and 56.4% reporting these foods in the open-recall 24HR. A kappa of 0.86 for sweet foods and 0.87 for salty/fried foods were found. Among the 251 participants that did not receive the WHO indicator questions, a lower proportion reported their child consumed a sweet or salty/fried food during the 24HR, (43.8% and 47.8%, respectively), indicating that a list-based 24HR may aid memory in recalls.

Conclusions: This study found strong agreement between measurement of sugary or salty/fried food consumption using an open-recall and a list-based 24HR among caregivers in Cambodia. This WHO measure may provide reliable data on unhealthy dietary patterns among young children; however, validation studies are needed.

Keywords: dietary assessment, infant and young feeding indicators, complementary feeding, open-recall and list-based 24HR, sweet or salty/fried foods

Conflicts of interests: none

PAB(T2)-40

Vitamin K content of cheese, yoghurt and meat products in Australia

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Background: Vitamin K is important for normal blood coagulation and may play a role in skeletal, neurological and vascular health. In the absence of a single biomarker for vitamin K status, estimates of dietary intakes are commonly used as an indicator of vitamin K status at the population level. However, the vitamin K food composition data required to estimate intakes are limited globally. As there are currently no nationally representative food composition data for vitamin K in Australian foods, we aimed to determine the vitamin K content of cheese, yoghurt and meat products purchased in Australia.

Methods: Primary samples (total n = 288) were purchased in three cities (Sydney n = 90, Melbourne n =114, Perth n = 84) over a 10-month period to account for seasonal variation. Samples were prepared as they would be consumed (cooked using common household methods where applicable), combined into 48 composite samples, frozen and transported to the Technical University of Denmark for analysis. We used a validated liquid chromatography with electrospray ionisation-tandem mass spectrometry method to measure the K vitamers, phylloquinone (PK) and menaquinones (MK) -4 to -10. Results are reported as means (± standard deviation for foods with multiple analytical samples) of duplicated or triplicated analyses.

Results: Each sample contained at least one K vitamer. PK was quantified in 28 foods with mean concentrations ranging from 0.54 µg/100 g (full-fat yoghurt) to 4.93 µg/100 g (lamb liver). MK-4 was quantified in 46 samples and predominated in all cheese products (Cheddar, feta, Mozzarella, Brie/Camembert, cream cheese, cheesecake). The greatest mean concentration of MK-4 was found in chicken leg meat at 58.16 ± 8.59 µg/100 g. MK-5 was found only in Cheddar (1.05 ± 0.30 µg/100 g) and cream (0.95 µg/100 g) cheeses, while only Cheddar cheese contained MK-8 (3.95 ± 2.19 µg/100 g). We found MK-9 in all cheese products. No samples contained quantifiable concentrations of MK-6, MK-7 or MK-10.

Conclusions: This study adds to the limited knowledge of the vitamin K composition of foods. Australia needs a comprehensive vitamin K food composition database to allow estimation of usual intakes in the Australian population.

Keywords: Australia, food composition, menaquinone, phylloquinone, vitamin K

Conflicts of interests: none

PAB(T2)-41

Using WHO/EURO's Nutrient Profiling Model for commercially available complementary foods to assess products sold in Senegal

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Background and Objectives: Some commercially produced complementary foods (CPCF) have the potential to improve nutrient intakes by providing critical micronutrients. Others are of concern due to high levels of added salt and/or sugar. WHO/EURO's CPCF nutrient profiling model (NPM) was used to assess the nutritional suitability of CPCF sold in Senegal for older infants and young children (IYC) 6-36 months of age.

Methods: In June 2021, 11 larger and 30 smaller stores were purposively sampled for purchasing CPCF in Dakar and Guédiawaye Departments, where all available CPCF were purchased. A total of 329 products were categorized according to the WHO/EURO's CPCF NPM, and the ingredient list and nutritional content provided on product labels were assessed against the NPM's category-specific nutrient/ingredients standards. CPCF were categorized as nutritionally suitable for older IYC if they achieved all category-specific nutrient/ingredients standards.

Results: Of the 329 CPCF products assessed, 76 were instant cereals, 194 purees, 49 meals and 10 snack/finger foods. Only 56 (17.0%) CPCF products passed all relevant NPM standards. This included 9.2% (n=7) of instant cereals, 21.7% (n=42) of purees, 14.3% (n=7) of meals and no snacks/finger foods. For the 'no added sugar/sweeteners' standard, 100% of meals and 81.4% (n=158) of purees met the NPM standard, while only 11.8% (n=9) of instant cereals and no snacks/finger foods met this standard. The NPM sodium standard was met by 82.9% (n=63) of instant cereals and nearly all fruit purees (97.5%, n=78). However, only one-third (n=1) of pureed meals with cheese and pureed meals with meat/fish and half (n=5) of all snacks/finger foods met the maximum sodium limit. All purees and meals and 93.4% (n=71) of instant cereals met the NPM fat standard versus 60.0% (n=6) of snacks/finger foods.

Conclusions: The majority of CPCF products sold in Senegal are nutritionally unsuitable for older IYC consumption, failing to achieve all category-specific NPM nutrient/ingredient standards. Using this NPM tool in the African context, where IYC malnutrition is prevalent, is both novel and valuable, enabling identification of CPCF suitable for promotion for IYC feeding based on their nutrient composition.

Keywords: Commercially produced complementary foods (CPCF), Nutrient profiling, Infants and young children, Nutrient composition, Senegal

Conflicts of interests: none

PAB(T2)-42

Effect of milk on the measurement of exhaled carbon monoxide in healthy Japanese non-smokers and current smokers

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Background and Objectives: One of the adverse products of smoking is carbon monoxide (CO). To date, three different exhaled CO monitors are used to assess smoking status in Japan. However, the sensor in these CO monitors has a cross-sensitivity to hydrogen (H2). Therefore, if H2 is included in the expiratory gas after taking indigestible carbohydrates, such as lactose, this can produce false higher readings, causing erroneous results. This study investigates the influence of consuming milk containing lactose on measuring CO in Japanese non-smokers and smokers.

Methods: Four healthy non-smokers and three current cigarette smokers (aged 22–60 years) were recruited. After staying overnight without smoking and eating, exhaled breath of the subjects was collected by breath collection bag. After consuming 200mL milk containing lactose at 9:00 am, exhaled breath was collected every 30 min for about eight hours. Then, the exhaled H2 and CO values in each bag were measured as a reference standard by gas chromatography. Further, CO in each bag was measured using three different portable CO monitors (A, B, and C) and compared with the value of a reference standard.

Results: After consuming milk, the median concentration of exhaled H2 was significantly increased (before: 6.2 ppm, after maximum value: 23.8 ppm, p=0.03). The H2 concentration measured by gas chromatography and the differences between CO value measured by portable CO monitors and gas chromatography were correlated (A: r=0.27, p=0.01, B: r=0.77, p<;0.01, C: r=0.21, p=0.02). After consuming milk, the values shown on the three portable CO monitors increased and were significantly higher (A: p=0.02, B: p=0.02, C: p=0.04) than those before consuming milk. Furthermore, the higher values of CO measured by CO monitors compared with the reference CO were observed for at least 8 hours.

Conclusions: The concentration of H2 in participants' breath increased after consuming milk containing lactose, which influenced the measurement of exhaled CO in the portable CO monitors. Therefore, before measuring CO with CO monitors in Japanese, the effects of taking milk should be considered.

Keywords: exhaled carbon monoxide concentration, carbon monoxide concentration monitor, lactose, smoking status, smoking cessation

Conflicts of interests: none

PAB(T2)-43

Assessment of dietary iodine intake among pregnant women from coastal and countryside areas

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Background and objectives: Geographic location can compromise the iodine intake of some population groups, especially those with higher nutritional requirements (e.g., pregnant women), as location influences the iodine concentration in food and food choices. To ensure iodine intake, Brazil implements a universal salt iodization strategy. Thus, the objective is to compare the iodine intake and its prevalence of inadequacy on pregnant women living in Brazilian coastal and countryside municipalities.

Methods: Pregnant women's data from the Multicenter Study of Iodine Deficiency in Brazil is the basis of this investigation. Data collection was carried out in 11 municipalities between 2018-2020 with four of them located in Brazil's coastal region. One 24-hour recall was applied to the sample, with replicates in a subsample (18.9%), following the Multiple Pass Method assisted by a photographic manual for food portion quantification. Food consumption data were entered in the GloboDiet software and later linked to the composition data from the Table of Iodine Composition in Food. Usual intake distributions were estimated from daily intakes and adjusted for the intra-individual variability by the UCD/NCI Simulating Intake of Micronutrients for Policy Learning and Engagement macro in SAS. Moreover, the prevalence of iodine inadequacy was estimated based on the average nutrient requirement of 160 mcg/day. Coastal and countryside distributions were modeled by age, season, gestational age, education, day of the week, and recall order. Significant difference was assumed in the absence of overlap between 95% Confidence Intervals (CI).

Results: Considering food only, usual iodine intake of pregnant women was 127.7mcg (95%CI:127.6-27.9), being inadequate for 82.6% (95%CI:82.4-82.7) of the sample. In comparison to countryside women (126.2mcg;95%CI:126.0-126.4), those living in coastal regions (36.4%) showed lower mean of usual intake (123.4mcg;95%CI:123.1-123.6). Also, the prevalence of inadequate iodine intake was significantly higher among coastal pregnant women (86.5%; 95%CI:86.3-86.8 versus 80.4%; 95%CI:80.2-80.6).

Conclusions: Pregnant women living in Brazilian coastal municipalities showed higher inadequacy of iodine intake than those from countryside. This result confirms that geographic location can impact iodine intake and its prevalence of inadequacy even in a country with universal salt fortification, suggesting that policies promoting adequate intake could be planned considering this influence.

Further Collaborators: Prof. Renata Junqueira Pereira (UFT) Prof. Carolina Abreu de Carvalho (UFMA) Prof. Danielle Góes da Silva (UFS) Prof. Nathalia Marcolini Pelucio Pizato (UnB) Prof. Franciane Rocha de Faria (UFMT) Prof. Sílvia Eloiza Priore (UFV) Prof. Gustavo Velásquez (UFMG) Prof. Naiara Sperandio (UFRJ) Prof. Miriam Rodrigues Barbosa (UFES) Prof. Anderson Marliere Navarro (USP) Prof. Claudia Choma Bettega Almeida (UFPR)

Keywords: iodine, pregnancy, food intake, diet, geographic locations

Conflicts of interests: none

PAB(T2)-44

Dietary diversity and its relationship to nutrient and food group intake among Japanese pregnant women

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Background: Dietary habits during pregnancy affect several pregnancy outcomes. In Japan, the Ministry of Health, Labour and Welfare has presented "Dietary Guidelines for Expectant and Nursing Mothers Starting Before Pregnancy," which recommend a well-balanced intake of necessary nutrients through a combination of various dishes and foods. However, most dietary surveys of Japanese pregnant women have assessed excess or deficiency of specific nutrients or food intake, and dietary assessments using dietary diversity has rarely been conducted. Therefore, this study examined the relationship between dietary assessment using dietary diversity and the intake of nutrients and food groups.

Methods: The survey was conducted between January and December 2011. A total of 194 women in the first trimester of pregnancy (8-15 weeks gestation) living in the Tokyo metropolitan area were included. The FFQ was administered to the subjects, and the number of foods consumed per day was calculated by converting the frequency of FFQ intake to a daily frequency if the answer was less than one day, such as "1-2 times a week" or "3-4 times a week. The number of foods consumed per day was used to classify the subjects into tertiles and compare nutrient intake and intake by food group.

Results: The average number of foods consumed per day calculated from the FFQ was 25.8. The average number of foods consumed per day by the highest group was 35.0, and those by the lowest group was 17.2, a difference of more than 10 points. In terms of nutrient intake, the highest group consumed more energy, protein, fat, iron, and folic acid than the lowest group, but less carbohydrate. The highest group consumed more vegetables, mushrooms, meat, and fewer cereals than the lowest group.

Conclusions: The group that consumed more foods per day was considered to have a higher intake of meat and vegetables,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

which increased the intake of nutrients such as protein and iron. While it is essential to consume various foods, the results also suggest the importance of adequate intake of cereals as a source of carbohydrates.

Keywords: Dietary Assessment, Dietary diversity, Pregnancy, Food intake

Conflicts of interests: none

PAB(T2)-45

High Dietary Quality with Alternative Health Eating Index-Taiwan and component Is Associated with Prevent Graft Kidney Function in post Renal Transplant Recipients in Taiwan

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Background and objectives. A successful of renal transplant is depends on the years of graft kidney function maintenance. Eating index was used to assess dietary quality and associated with several chronic diseases in global. However, an index which adapted to national population is necessary to be developed. The Alternative Healthy Eating Index-Taiwan (AHEI-T) version was modified from Alternative Healthy Eating Index-Taiwan (AHEI) based on Taiwan's dietary recommendations. The study is to investigate the association between AHEI-T and graft kidney function in renal transplant recipients (RTRs).

Methods: A total of 102 RTRs aged more than 18 years or above with a functioning allograft and without any acute rejection in the past 3 months were enrolled from September 2016 to June 2018. Laboratory data were obtained from medical record; Chronic kidney disease (CKD) was defined as an estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 m2 according to Kidney Disease Outcomes Quality Initiative (KDOQI) guideline. Statistical analyses were performed using SAS software 9.4 version. The scores of AHEI-T and component were divided into quartiles.

Results: The RTRs with higher AHEI-T have older age, higher eGFR and higher scores of dietary fruit, vegetable, wholegrains ratio, white and red meat ratio, and nut and soybeans. Logistic regression analysis adjusted age, gender, calorie intake and comorbidity index was demonstrated that the highest quartiles of the AHEI-T had 90% (odds ratio [OR], 0.10; 95% confidence interval [CI], 0.03–0.43, p for trend <; 0.01), lower risk of CKD. The highest quartiles of wholegrains ratio, and white and red meat ratio were associated with 67% (OR, 0.33; CI, 0.13 - 0.85 p for trend <; 0.05) and 72% (OR, 0.28; CI, 0.08 - 0.97 p for trend <; 0.05) low odds of CKD, respectively. In addition, RTRs with highest quartiles of red/processed meat had 10.4 times higher risk of CKD (OR, 10.38; CI, 2.16 - 49.85, p <; 0.01).

Conclusion: High AHEI-T and the component of wholegrains ratio, white and red meat ratio were associated with CKD prevention. Red/processed meat was associated with poor graft kidney function.

Keywords: dietary quality, eating index, Alternative Health Eating Index-Taiwan, renal transplant recipients, chronic kidney disease

Conflicts of interests: none

PAB(T2)-46

A study on nutritional status of patients with mild cognitive impairment

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Background and objectives: Aging populations is rising by years in Taiwan. Mild cognitive impairment (MCI) has become the important health issue. Based on current knowledge, the etiology of cognitive decline is incomplete. Dietary intake may be a potential modifiable factor to delay the deterioration of disease. This study is aimed to comparison between dietary food and nutrients intake and in patients with mild cognitive impairment.

Methods: A total of 50 subjects were recruited in this cross-sectional study from July, 2019 to September, 2021. According to clinical dementia rating (CDR) and mini-mental state examination (MMSE), subjects are divided into healthy group (CDR = 0 and MMSE ≧ 26) and MCI group (CDR ≧ 0.5 and MMSE ≧ 26). Dietary data was obtained by 3-day dietary records and nutrients intake were calculated by trained dietitian. Statistical analyses were performed using statistical SAS software version 9.4. Data was expressed as mean ± standard deviation.

Results: Participants with extremely or missing dietary data were excluded (n = 10) and 40 subjects remained to analysis. The mean age and body mass index were 71.4 ± 6.6 years old and 25.0 ± 3.2 kg/m2, respectively. Subjects were divided into healthy group (n = 19) and MCI group (n = 21). Compared with healthy group, MCI group significantly have higher dietary copper and lower low fat beans, fish, eggs and meat intake. Multivariate regression analysis adjusted age and gender was showed that dietary calcium (β = 0.001, P = 0.04) and fruit (β = 0.81, P = 0.01) intake were positively associated with MMSE. Dietary copper (β = 0.001, P = 0.02) intake was positively associated with CDR. Low fat beans, fish, eggs and meat intake (β = -0.08, P = 0.01) was negatively associated with CDR.

Conclusions: MCI group have higher copper and lower low fat beans, fish, eggs and meat intake. Higher dietary calcium, fruit and low fat beans, fish, eggs and meat, and lower copper intake were associated with protective predictors of MCI. Further randomized control studies should be warranted.

Keywords: mild cognitive impairment, food intake, nutrient intake, clinical dementia rating, mini-mental state examination

Conflicts of interests: none

PAB(T2)-47

Assessing the applicability of nationally-adapted sentinel food lists at the subnational level in six geographically unique food systems.

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Background and objectives: High quality diets are essential for preventing malnutrition and diet-related NCDs, yet to date there are limited ways of rapidly assessing the diet quality of populations. Since 2021, USAID Advancing Nutrition has supported The Global Diet Quality Project to develop nationally adapted sentinel food lists for adults in 53 countries and infant and young child feeding (IYCF) sentinel food lists for children 6-23 months in 92 countries. Sentinel foods refer to context-specific foods that are frequently consumed within a food group in a given population (Herforth et al. 2020). The primary objective of this study is to determine if national-level sentinel food lists adequately capture food groups reported to be consumed at subnational levels, and if not, to determine the difference in diet quality indicators such as the minimum dietary diversity score in women of reproductive age (MDD-W) and in children (MDD). Secondary objectives include identifying whether the national-level sentinel food lists more accurately capture some food groups than other food groups for women 15-49 years and/or children 6-23 months.

Methods: Using datasets from six different dietary recall studies from subnational administrative areas in Bangladesh, Benin, Columbia, Kenya, Malawi, and Nepal, we will compare responses from open recall dietary questions or weighed food records to each country's adapted sentinel food lists. Differences will be tested by comparing diet quality indicator estimations (MDD-W, MDD) for each subregion from open recall and the sentinel list using a McNemar's test for difference in paired proportions .

Results: Analysis is currently in progress. Results will show how suitable nationally-adapted sentinel food lists are for use at the subnational level to measure population-level diet quality, inclusive of any differences in capturing diet quality indicators and food group consumption.

Conclusions: This study will demonstrate the suitability of national-level sentinel food lists for use at the subnational level for the rapid measurement of diet quality for women and children in unique geographic contexts.

Keywords: Diet quality, sentinel food lists, tool validation, measurement

Conflicts of interests: USAID financially sponsored USAID Advancing Nutrition to conduct this validation study of the nationally adapted sentinel food lists

PAB(T2)-48

Nutrient composition of fresh produce – assessing variability between European countries for substantiating food claims

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Background and objectives: Food claims can help translate distant health recommendations into more accurate and easy to access messages at the point of sale. In the European region, non-prepackaged fresh produce, such as fruits and vegetables, is excluded from mandatory nutrition labelling. However, the product's nutrient content is central to comply with conditions of use of such claims. Accurate nutrient composition information is key to establishing which products contain a sufficient amount of nutrients to bear claims. National Food composition databases (FCDBs) are the main sources of the nutrient composition, yet, fresh produce composition is highly dependent on cultivar and external characteristics. This study examines the variability in nutrient content for substantiating the use of food claims in fresh produce, in particular fruits and vegetables.

Methods: We sampled and assessed the nutrient content variation in fresh fruits and vegetables from FCDBs in Germany, Belgium, and the Netherlands retrieved from EuroFIR. The analysis focused on those macronutrients and micronutrients highly affected by external conditions and object to food claims. A one-way ANOVA analysis was used to test the differences in nutrient content between countries, and multiple testing was accounted for with a post-hoc test. We also studied whether a food item would have sufficient nutrients to carry a claim in all countries.

Results: Preliminary results show that food composition does differ between countries, in some cases resulting in only some countries being able to make a claim. It was also observed that some differences are more pronounced for vitamins highly affected by external conditions.

Conclusions: This study illustrates the heterogeneity that exists between national FCDBs. The lack of nutrient composition of different cultivars between countries affects the representatives of fresh produce varieties and derived used of food claims. Therefore, more effort should be put into collecting and integrating data on cultivars, growth conditions, seasonality, and production region. Widely available and cost-efficient nutrient composition sources could economically benefit small and middle scale producers to sustain food claims on their products.

Keywords: Food composition databases, nutrient variability, nutrition claims, health claims, fresh produce

Conflicts of interests: none

PAB(T2)-49

The use of Mini Nutritional Assessment for malnutrition and sarcopenia assessment in elderly home care residents in Indonesia

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Background and objectives: Sarcopenia increases the risk of comorbidities and mortality in older adults. It coexists with malnutrition and shares many components related to age-related declines. This study aimed to explore the use of Mini Nutritional Assessment (MNA) in assessing sarcopenia in the elderly.

Methods: A total of 84 elderly home care residents (mean age 71.3 ± 7.4 years; 30 (35.7%) male) in Yogyakarta, Indonesia were enrolled in this cross-sectional study. Nutritional assessments were performed for body mass index (BMI), body circumferences, body composition (OMRON HBF-375 bioimpedance analyzer), and grip strength. Mini Nutritional Assessment (MNA) questionnaire was used to assess malnutrition risk. Sarcopenia was defined according to the Foundation for the National Institutes of Health (FNIH) Sarcopenia Project among Asian older adults.

Results: Mean BMI was 21.2 ± 3.7 kg/m2, with 49 (58.3%) subjects being at risk of malnutrition and 18 (21.4%) categorized as malnourished according to MNA. The prevalence of sarcopenia was 13.1%, and it was higher in male and in malnourished participants (p<;0.01). Participants who were malnourished had significantly lower calf circumference (median: 28.0 vs 32.0 cm, p=0.024) and arm circumference (22.5 vs 26 cm, p=0.042), compared to those who were well-nourished, but hand-grip strength and skeletal muscle mass index-kg/m2 (SMMI) were not statistically different (p=0.27 and p=0.09, respectively). Correlations between MNA score and SMMI (rs=0.395, p<;0.001), calf circumference (rs=0.345, p=0.001), and grip strength (rs=0.237, p=0.030) were also observed. An MNA score under 9.5 gave the highest sensitivity and specificity cut-off of older people at risk of sarcopenia (AUC=0.809; p=0.001; 72.7%; 63.0%).

Conclusions: Sarcopenia was not uncommon in malnourished elderly and elderly at risk of malnutrition. MNA score correlates positively with muscle mass and strength indices, suggesting that it might be a potential tool to recognize older people with sarcopenia.

Keywords: Mini Nutritional Assessment, Sarcopenia, Elderly, Home care, Malnutrition

Conflicts of interests: This was funded by Ajinomoto Co., Inc.

PAB(T2)-50

Royal jelly controls intestinal stem cell homeostasis via SIRT1/mTORC1 axis

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Background and objectives: The homeostasis of the gut epithelium is maintained by the self-renewal and differentiation of intestinal stem cells (ISCs). As previous studies have described the aging-related deterioration of adult stem cell function, developing the interventions to increase the adult stem cell pool could be an efficient strategy to prevent the tissue decline during aging. On these backgrounds, we try to discover how royal jelly (RJ) affects the ISCs function.

Methods: Mice were administered with RJ at 500 mg/kg/day or with 10-Hydroxydecanoic acid, which is an ingredient of RJ, at 10mg/kg/day by oral gavage for more than 6 weeks. Small intestine was isolated and used for immunohistochemistry. Proliferative function of ISCs was assessed by organoid culture from isolated crypts. ISCs and Paneth cells (stem cell niche) were isolated from Lgr5-EGFP-IRES-CreERT2 mice and were co-cultured for assessing the ISC and Paneth cell function.

Results: RJ treatment of intestinal crypts (including ISCs and Paneth cells) promoted organoid formation from both young and old mice derived crypts. While RJ treatment of isolated Lgr5-positive ISCs did not promote organoid formation, Paneth cells isolated from RJ-treated mice stimulated organoid formation in co-culture with control ISCs. RJ treatment increased the number of ISCs and Paneth cells in vivo. Moreover, we found 10-Hydroxydecanoic acid, an ingrediend of RJ, mimiced the effect of RJ ex vivo and in vivo. In order to probe the mechanism of ISCs proliferation by RJ, ISCs and RJ-treated Paneth cells were co-cultured with the CAMKK inhibitor STO609, AMPK inhibitor Compound C, or the specific SIRT1 inhibitor EX527. STO609, Compound C or EX527 treatment blocked the promotion of organoid formation by RJ-treated Paneth cells. Moreover, mRNA of SIRT1 and Nampt was upregulated in RJ-treated ISCs. Finally, pS6 staining of intestine from RJ treated mice showed mTORC1 activation by RJ. These all results suggest that CaMKK-AMPK-Nampt-SIRT1-mTOCR1 pathway in ISCs mediates the effect of RJ like calorie restriction (Igarashi M et.al., Cell.2016)

Conclusions: RJ expands the ISC pools though Paneth cell activation and mimics the effect of calorie restriction on ISCs. These results indicate that RJ could modify intestinal environment via Paneth cell and ISCs activation.

Keywords: royal jelly, intestinal stem cell, paneth cell, SIRT1, organoid

Conflicts of interests: he is employee of Yamada Bee Company, Inc. The other authors declare no competing interests.

PAB(T2)-51

Development of the mynutritionis platform for improving the nutritional status of stunting children under five in Subang Regency, west Java Province, Indonesia

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Background and Objective: Subang Regency is an area located in the West Java Province, Indonesia. Stunting is one of the nutritional problems of children under five in this region. In terms of food security, Subang Regency has sufficient food security. This indicates that stunting is not caused by a lack of food availability. Another factor that is suspected to be one of the causes of stunting in Subang Regency is the lack of nutritional knowledge of mother, especially about arrange foods that can meet Recommended Dietary Allowance (RDA) of their children. The Covid-19 pandemic has affected several health activities, such as the decline in Integrated Healthcare Center (Posyandu) activities to monitoring and educating children's nutrition. Based on this, a platform (website) was created that provides information about children under five nutritional status as well as how to give balance nutrition.

Methods: Prior to the creation of the platform, a Forum Group Discussion (FGD) was first conducted. The FGD was carried out with the head of the Primary Healthcare (Puskesmas), nutritionist, posyandu and village representatives, the public health and the food security office of Subang Regency for the preparation of the features contained in the platform. After agreeing on the features contained in the platform, then the creation of the platform is carried out. After the platform was created and tested, socialization was carried out to related parties.

Results: In this platform, mothers of children only need to enter data on weight and/or height and age to find out how much their children's RDA are. In addition, this platform also displays what foods can be given to meet RDA. The foodstuffs displayed on this website are foods that are available in the Subang Regency area so that people can reach them. In addition, this platform also provides several recipes for processing recommended food ingredients.

Conclusions: Therefore, with this platform, mothers of children can provide nutritious food every day. It is hoped that when this process continues, there will be an improvement in children's nutritional status, especially in reducing the incidence of stunting.

Further Collaborators: This research received a grant in the TOP 120 social project Innovillage program organized by BUMN for Indonesia and Telkom University

Keywords: Stunting, Platform, Nutritional status, Children Under Five, Indonesia

Conflicts of interests: none

PAB(T2)-52

Double burden of malnutrition and cardiometabolic risk factors in Ecuadorian women

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Background and objectives: Both sides of the double burden of malnutrition, DBM, have been associated with adverse effects on health. Anemia or iron-deficiency anemia affects physical performance and health outcomes during pregnancy and birth. Being overweight is associated with an increased risk of cardiovascular disease mortality, and a high prevalence of altered cardiometabolic risk factors, CMRF, such as blood glucose, cholesterol, triglycerides, systolic and diastolic blood pressure. However, it is not clear if DBM represents a differential risk on health that may be attributed to under and over-nutrition. The objective of the present report was to compare cardiometabolic variables between three groups of women: apparently healthy, overweight, and affected by DBM i.e. coexistence of overweight and iron deficiency.

Methods: Data from the National Survey of Health and Nutrition of Ecuador were analyzed. The analysis included 1992 women from 18 to 59 years: 664 apparently healthy, 664 overweight, 664 DBM. DBM was considered as the coexistence of overweight and iron deficiency without anemia i.e. non-anemic and low ferritin. The Kruskal Wallis test was used to evaluate the differences between groups in CMRF i.e. blood glucose, cholesterol, triglycerides, systolic, and diastolic blood pressure. In this analysis, the post hoc test was the Bonferroni test. The SPSS statistical software package version 18.0 was used to conduct the analyses.

Results: Comparing with the apparently healthy group, the women affected by DBM had higher levels of all CMRF evaluated, p-value less than 0.05 for all. However, compared with the overweight group, the women affected by DBM showed lower levels of blood glucose, cholesterol, triglycerides, p-value less than 0.05; but, diastolic and systolic blood pressure were similar, with a p-value greater than 0.05.

Conclusions: The Ecuadorian women of reproductive age affected by DBM may present differential comportment of CMRF compared with those affected by overweight.

Further Collaborators: Acknowledgements to the Escuela de Nutrición y Dietética Universidad de Antioquia, Colombia and to the Facultad de Ciencias Médicas- Universidad de Cuenca, Ecuador, for the financial support.

Keywords: Overweight, Iron deficiency, Double burden of malnutrition, Cardiometabolic risk factors

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-53

Infant and young child feeding practices and nutritional status in urban and rural area of South Kivu, Democratic Republic of Congo: a descriptive study

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Background and objectives: The optimal infant and young child feeding practices (IYCF) are crucial to improving children's health and nutritional status. In the Democratic Republic of the Congo (DRC), 43% of preschool children were stunted (Demographic Health Survey 2019). This study aimed at assessing the feeding practices and nutritional status of children aged 6-23 months from two areas, Kadutu (urban) and Miti-Murhesa (rural), in South Kivu, eastern DRC.

Method: A descriptive cross-sectional study conducted from August to September 2021 on randomly selected 530 children aged 6 to 23 months and their mothers in Kadutu and Miti-Murhesa. Socio-demographic characteristics were collected and IYCF practices were assessed using 24-hour recall. Nutritional status was determined according to the World Health Organization 2006 standards.

Results: Median (IQR) age was 13 months (9-17, n=522) and sex ratio 1.05. Overall, 97.1% of children were ever breastfed between 0-24 months and 85.4% within the first hour of birth. However, only 60.6% of children were exclusively breastfed to 6 months. The median age of introduction of liquid, semi-solid, solid complementary food was 4, 6 and 8 months respectively. The median age for weaning was 12 months. Overall, 68.8%, 10.8%, 8.7%, 12.9% of children, received water, sugar water, tea+soy, tea+milk respectively, in addition to breastfeeding the day before the survey (n=388). In both areas, complementary feeding was poor in food of animal origin, fruits and vegetables. Most children (88.5%) consumed porridge consisting only of grain, roots, tubers (sorghum, soybeans, plantains and maize) and water. Among these children, only 42% met minimum dietary diversity, 19% a minimum meal frequency and 10% reached a minimum acceptable diet. Stunting and wasting affected 36.6% and 4.9% respectively, without any difference between urban (38.6% and 3.7%) and rural areas (34.2% and 6.6%).

Conclusion: Majority of mothers breastfeed, however many introduce complementary food very early in their child's life. The diversity of complementary foods in the study area was found to be sub-optimal and could explain at least partly this high prevalence of stunting. Upgrading nutritional composition of the cereals complementary foods should be of highest priority for improving the young child nutrition.

Keywords: Breastfeeding, Exclusive breastfeeding, complementary food, South Kivu, DR Congo

Conflicts of interests: none

PAB(T2)-54

A method to monitor structural changes of the nutritional quality of packaged food supply over time

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Background and objectives: Food and beverage companies reformulate their products to improve their nutritional quality, adapt to evolving consumer needs and preferences, and to follow public health policies, both local and global. More broadly, reformulation of the global packaged food supply by multiple companies has the potential to improve diet quality and global public health. This study applied a product portfolio evaluation method to two subsets of the international Mintel New Products Global Database for years 2016-2018 and 2018-2020. The present goals were to provide feasible targets for reformulation that were category specific [1] and to monitor the structural changes of the nutritional quality of the packaged food supply over time.

Methods: The three components of the product portfolio evaluation system were (1) identification of nutrients relevant to each food category, (2) assignments of products into nutritionally homogeneous sub-categories and (3) the development of feasible nutrient thresholds for "best of class" products. Nutritional categories were matched from one period to another using products launched during the year 2018, which were present in both periods of time.

Results: The category-matching process between the two periods of time resulted in three different outcomes: a single category in 2016-2018 matching a unique one in 2018-2020, multiple categories merging into one, or a single category splitting into smaller ones. The structure of categories evolved in 38% of cases. As an example, the unique 2016-2018 Pizzas category split into two categories between 2018 and 2020. The first category reflects a healthier pizza offering than the second one which gathers mostly indulgent pizzas, despite an absence of evolution of the average nutrient thresholds overall. From a qualitative perspective, the threshold remained stable for 85% products, indicating that nutrient thresholds remain relevant for most products over multiple years. Whenever nutrient thresholds were evolving, they appeared to move to nutritionally more stringent thresholds, especially for the two disqualifying nutrients sodium and sugars.

Conclusions: The present method enables one to determine category-specific nutrient thresholds applicable at one time point, and, when combined with a category-matching algorithm, to monitor the structural and qualitative changes in the manufactured food supply over time. This method can support decision making for the creation, or merging, of product categories and the evaluation of their nutrient thresholds for food formulation.

References: [1] Leroy, F.; Rytz, A.; Drewnowski, A.; Tassy, M.; Orengo, A.; Charles, V.R.; Green, H. A New Method to Monitor the Nutritional Quality of Packaged Foods in the Global Food Supply in Order to Provide Feasible Targets for Reformulation.

Nutrients 2021, 13, 576. https://doi.org/10.3390/nu13020576

Keywords: public health, nutrient, food supply, packaged food, evolution

Conflicts of interests: Marie Tassy, Andreas Rytz, Alec Lecat, Emma Jacquier, and Véronique Rheiner Charles were all employed by Nestlé at the time of the study and Adam Drewnowski is a member of the Nestlé Scientific Advisory Board. There was no corporate influence on the design of the study; in the collection, analyses, or interpretation of data. Adam Drewnowski, the originator of the Nutrient Rich Food Index, a nutrient profiling model, has received grants, contracts and honoraria from entities, both public and private, with an interest in nutrient profiling of food products.

PAB(T2)-55

Dietary choline and betaine intakes are associated with anthropometric measures in young children from Vancouver, Canada

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Background and objectives: Choline is the precursor for acetylcholine, phosphatidylcholine, sphingomyelin, and betaine. Little is known about dietary choline and betaine intakes during childhood and the relationship to indicators of growth (anthropometric measures). The objective of this study was to determine the relationships between anthropometric measures, and choline and betaine intakes and status in children.

Methods: Participants were from a randomized controlled trial of arachidonic acid and docosahexaenoic acid supplementation between ages 1 (1y) and 2 years (2y); or a cross-sectional study at age 5-6 years (6y). Anthropometric measures were assessed using weight, height, and BMI using the WHO Child Growth Charts z-scores stratified by sex. Dietary information was collected by three non-consecutive day food records (1y n=110; 2y n=86) or three non-consecutive day 24-hour recalls (6y n=265). Intakes were estimated using the Canadian Nutrient File and USDA database for choline. Plasma free choline and betaine concentrations were quantified using LC-MS/MS.

Results: Daily choline and betaine intakes were (mean [SD], respectively) 174 (56.2) and 45.6 (27.1) mg at 1y; 205 (67.5) and 62.5 (40.3) mg at 2y; and 249 (94.3) and 87.2 (39.9) mg at 6y. At all ages, the top sources of choline were eggs and dairy (~48%), and grain products (~62%) for betaine. Children that consumed eggs had a greater odds of meeting the Adequate Intake for choline (OR=5.60 at 1y, OR=8.14 at 2y, and OR=12.6 at 6y; all P<;0.001) than none egg consumers. Plasma free choline and betaine concentrations were (mean [SD], respectively) 10.4 (3.3) and 41.1 (15.4) µmol/L at 1y; 8.50 (2.30) and 39.0 (12.1) µmol/L at 2y; and 8.62 (2.13) and 45.3 (13.7) µmol/L at 6y. Dietary choline intake was positively associated with z-scores of weight-for-age, length/height-for-age, weight-for-length (1-2y), and BMI-for-age (6y) (all P<;0.05). Dietary betaine intake was positively associated with weight-for-age, length-for-age, weight-for-length, and BMI-for-age (all P<;0.05). Plasma betaine was inversely associated with BMI-for-age at 6y (r=-0.168; P=0.008).

Conclusions: These findings suggest that anthropometric measures are associated with choline and betaine intakes and plasma betaine in young children. The role of choline metabolism in growth and body composition during development requires further investigation.

Keywords: Nutrient adequacy, Micronutrients, Child growth, Toddlers

Conflicts of interests: Funding was received from Egg Farmers of Canada, but had no role in the study design and data analyses

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PAB(T2)-56

Assessing nutrient intakes of Canadian children and adolescents in schools

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Background and objectives: The diet quality of Canadian children is suboptimal and unhealthy diets contribute to increased prevalence of childhood overweight and obesity. The school food environment can influence children's food choices and consumption patterns thereby impacting children's health. Monitoring nutrient intakes of children and adolescents at school is critical to understanding the school food environment. The nationally representative Canadian Community Health Survey (CCHS) Nutrition 2015 provides an opportunity to investigate nutrient intakes by location of food consumption. Therefore, the objective was to examine nutrient intakes of Canadian children and adolescents in schools.

Method: Intake data from the CCHS 2015 Public Use Microdata File first 24-hour dietary recall was used to estimate intakes of energy, macronutrients, nutrients of concern (i.e., sodium, saturated fat, sugar), and micronutrients of interest (i.e., calcium, fibre, iron, potassium) for children and adolescents between 2-18 y at schools. Nutrient intakes were expressed as means and as a proportion of total daily intake and are reported by Dietary Reference Intake (DRI) group. Participants who reported no food consumption, those with invalid energy intake and breastfeeding women were excluded.

Results: Across all DRI groups, children consumed 552.3±14.3 calories at school, representing 29.2% of their daily energy intake. Males 14–18 y consumed the lowest proportion of their daily energy intake at school (24.1%±1.6) and 4–8 y consumed the highest (32.3%±1.3). For all participants, the proportion of sodium, saturated fat and sugar consumed at school was 30.6%±0.8, 27.5%±0.8 and 30.5%±0.8. Notably, 4–8 y consumed the largest proportion of their daily sodium intake (33.8%±1.6) at school and males 14-18 y had the highest mean sodium intake

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DOI: 10.1159/000530786

(1010.8±104.4 mg). For sugar, 2-3 y reported the highest intakes (39.2±11.2 g) and consumed the largest proportion of their sugar intake (44.1%±12.4) at school. For all nutrients, calcium was consumed in the lowest proportion (25.2%±0.7) and fibre was the highest (31.7%±0.8).

Conclusions: Findings demonstrate that Canadian children consume 29% of their daily energy intake at school and contribute to an understanding of nutrient intakes of children while at school. This knowledge informs and supports the development of a national school food program.

Keywords: school food environment, child nutrition, dietary intakes, Canadian Community Health Survey Nutrition 2015

Conflicts of interests: E.Z. is a recipient of a Feeding Kids, Nourishing Minds School-Based Nutrition Graduate Award. The Feeding Kids, Nourishing Minds School-based Nutrition Research Initiative was made possible through an unrestricted donation to the Joannah and Brian Lawson Centre for Child Nutrition by President's Choice Children's Charity (PCCC). The funding sponsor had no involvement in the present research.

PAB(T2)-57

Development and Validation of a semi-food frequency questionnaire (Thai semi-FFQ) for urban and semi-urban at-risk populations with metabolic syndrome

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Background and Objectives: Semi-food frequency questionnaire (semi-FFQ) is one of the tools to assess the relationship between diet and risk of diseases. The aim of this study is to develop and validate the semi-FFQ for at-risk people of metabolic syndrome.

Methods: In the development phase, we used the single food items data from Thailand national food consumption survey in 2016 to analyze the list of food and proportionate amount. Data on Thai mixed-dish food were collected from 5 canteens at Siriraj Hospital in Thailand. The three sampling dishes from each menu were weighted for the major ingredients. The nutritive values were calculated using the Thai food composition software program. The nutrient profiling criteria (NP) was used to classify those menus. In the validation phase, participants were recruited from Siriraj-health cohort study. The reference indicator to compare with the semi-FFQ was the biochemical results of the participants.

Results: ninety-seven food items of 8 food groups and 5 serving size choices were included in the semi-FFQ. The food groups were fruits (n=18), beverage (n=10), snacks and Thai desserts (n=29), Thai mixed-dishes (n=32), egg menus (n=3), and dressing (n=5). The Thai mixed-dish were classified into 3 groups: a la carte, noodles, and rice with toppings. The content validity of semi-FFQ was evaluated by 3 nutrition specialists. The score was 0.97. The validation results were associated between three major nutrients for metabolic syndromes (sugar, fat, and sodium) and biochemical results (fasting blood glucose, lipid profiles, blood pressure and 24-hour urine sodium). Ninety-four participants were in the validation phase (54 unrequired urine collection, 40 required urine collection). Level of biochemical results of each key metabolic syndrome nutrient significantly increased with the rise of semi-FFQ estimated intakes. Correlation coefficients (r): fasting blood glucose; r=0.293 in fruits, r=0.285 in desserts. Triglyceride; r=0.252 in a la carte-dish. LDL-cholesterol; r=0.205 in rice with toppings-dish. Systolic blood pressure; r=0.272 in snacks and r=0.190 in a la carte-dish.

Conclusions: The final semi-FFQ was useful for assessing dietary food pattern of Thai populations who are at risk for non-communicable diseases.

Keywords: Metabolic syndrome, Semi-food frequency questionnaire, Thai nutrient profiling, Validation

Conflicts of interests: none

PAB(T2)-58

Effects of eating and exercise patterns on energy deficiency in free-living Korean male soccer players

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Background and objectives: Excessive exercise energy expenditure (EEE) and limited energy intake (EI) in athletes result in energy deficiency, which can cause physiological impairment. To monitor the energy deficiency in athletes, the ratio between measured and predicted resting energy expenditure (REEratio) has been recommended. However, there is no study on the effects of eating and exercise patterns on the REEratio. Therefore, this study aimed to assess the 7-day EI and EEE patterns of free-living athletes and analyze their effects on the REEratio.

Methods: Eleven Korean male collegiate soccer players completed the 7-day dietary records for EI and heart rate monitoring for EEE. Body composition was measured using dual-energy x-ray absorptiometry. Measured REE was evaluated using the Douglas bag method and predicted REE was calculated using the organ-tissue prediction equation. EI and EEE patterns of the participants during the training and rest days were analyzed; further, their effects on the REEratio were analyzed using regression analysis.

Results: Mean REEratio was 0.96 ± 0.08, and 7-day EI and eating frequency were 3,308 ± 508 kcal/d and 4.8 ± 0.8 times/d, respectively; there was no significant difference between training and rest days in eating patterns (3,350 ± 458 vs. 3,203 ± 807 kcal/d, p = 0.607, 5.1 ± 0.8 vs. 4.2 ± 1.3 times/d, p = 0.062, respectively). The 7-day EEE and exercise frequency were 1,519 ± 364 kcal/d and 1.7 ± 0.5 times/d, respectively, and training day

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

exhibited significantly higher EEE and exercise frequency than rest day (2,009 ± 419 vs. 295 ± 322 kcal/d, p <;0.001, 2.2 ± 0.5 vs. 0.4 ± 0.5 times/d, p <;0.001, respectively). The regression analysis showed that the athletes with higher EI were more likely to have higher REEratio (R2= 0.54, p = 0.009), and the higher eating frequency during rest day can result in higher total EI (R2 = 0.42, p = 0.032).

Conclusions: There is high risk of energy deficiency in Korean male collegiate soccer players, and EI affects the REEratio, but EEE has no effect on the REEratio. Increased eating frequency, especially during rest days, might help prevent the decrease in the REEratio and energy deficiency in athletes.

Keywords: energy deficiency, REEratio, athletes, eating patterns, exercise patterns

Conflicts of interests: none

PAB(T2)-59

Reliability of a web-based time-use diary (MEDAL) in assessing children's meal intakes using food photography taken by parents as reference

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Background and objectives: My E-Diary for Activities and Lifestyle (MEDAL) is a web-based time-use diary developed to assess diet and movement behaviour of Asian school children. This pilot study aimed to determine the reliability of MEDAL in assessing dietary intake of Malaysian school children using food photography taken by parents as the objective measure.

Methods: A total of 28 children aged 10-11 years recorded their daily activities in MEDAL for 4 days (2 weekdays and 2 weekend days). Over the four-day period, parents took meals and snacks photos consumed by their children (before and after consumption). The reliability of child-reported food items in MEDAL was determined by comparing their MEDAL reports to food photos taken by parents and classified as matches, omissions, or intrusion.

Results: The total food photos (n=307) submitted by parents was 91.4% of the total minimum expected reports (n=336 eating occasions) for 4 days. Overall, the match, omission, and intrusion rates were 69.0%, 34.1%, and 20.1%, respectively. Carbohydrate-based items from “Breads, spreads, and cereals” and “Rice and porridge” food categories were the most accurately reported (total match rates 74.6% and 75.0%, respectively). “Snack and dessert” items were most omitted (omission rates 48.4%). “Drinks” and “Milk, cheese and yogurt” items were most intruded (intrusion rates 29.0–29.7%). Compared to boys, girls reported more matches (74.6% vs. 57.2%) and fewer omissions (25.7% vs. 52.0%) and intrusions (15.1% vs. 30.9%).

Conclusions: Children were able to report their food and drink intake in MEDAL although some items were omitted and intruded when compared to food photography taken by parents. Omission of snacks and desserts might be attributable to multitasking—like eating while watching television or studying. The result of intrusion is further limited by the fact that parents might forget to photograph the drinks. MEDAL is a promising tool to assess the dietary intake of Malaysian school children aged 10-11 years.

Keywords: Children, Dietary intake, Time-use diary, Food photography, Reliability

Conflicts of interests: none

PAB(T2)-60

Contribution of organ mass on resting energy expenditure in Japanese male athletes

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Background and objectives: Estimated energy requirement is predicted by multiplying resting energy expenditure (REE) with physical activity level, and is used to determine individual energy needs. Therefore, it is important to explore the factors that influence REE. In athletes, fat-free mass (FFM) is a major determinant of REE. However, FFM is a heterogeneous compartment with a wide range of specific metabolic rates. Particularly, the brain, liver, heart, and kidneys have high metabolic rates. Few studies of organ mass on REE in athletes have been undertaken. This study aims to investigate the contribution of these organs, the components of FFM, on REE in male athletes.

Methods: A total of 31 Japanese male athletes (age, 20 ± 0.9 years) with normal levels of serum triiodothyronine were included in the study. REE was measured via indirect calorimetry using the Douglas bag technique. Body compositions were measured using dual-energy X-ray absorptiometry (DXA). Fat mass (FM), adipose tissue mass (AT), skeletal muscle mass, bone mass, and residual mass were calculated using data derived from DXA measurements. Mass of the brain, liver, and kidneys was measured by magnetic resonance imaging, and mass of the heart was estimated by echocardiography. The total mass of the brain, liver, kidneys, and heart was used as organ mass (OM) for the analysis. Multiple regression analysis was used to assess the contribution of FFM, FM, and mass of organs on the variance of REE.

Results: Total mean body weight and FFM were 76.0 ± 8.2 kg and 65.6 ± 5.7 kg, respectively. Significant correlations between REE and all body components except body fat percentage, FM, and AT were observed. In components of FFM, OM most highly correlated with REE (r=0.707, p<;0.001). OM was an independent factor of REE and explained 50.0% of the variance in REE in athletes. The relative contribution of high metabolic organs to REE appeared to be consistent regardless of the body size.

Conclusions: The OM would be the most effective predictor of REE in athletes. This information might well lead to a more

detailed understanding of individual differences in athlete's REE.

Keywords: resting energy expenditure, athletes, fat-free mass, organ mass, MRI

Conflicts of interests: none

PAB(T2)-61

Relationship between nutritional status and nutritional interventions on length of stay and clinical outcomes of corona virus disease (COVID) 19 patients

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Introduction: Malnutrition in particular undernutrition and overweight/obesity, alters the immune response, increasing the risk of infection, such as influenza and coronavirus. Proper diet and good nutritional status are considered as essential elements for an optimal immune response to prevent infection. Various nutritional interventions, such as oral nutritional supplements (ONS), dietary management and counselling, have shown positive results in patient care. Nutritional status and diet modulate inflammation and immune function and influence COVID-19 outcomes. This study aims to evaluate the relationship between nutritional status and nutritional interventions with length of stay (LOS) and clinical outcomes in COVID-19 patients in Dr. Wahidin Sudirohusodo Hospital, Makassar, Indonesia.

Method: Clinical data of 1726 subjects were collected from hospital's medical record in a cohort retrospective study method between June – September 2021. Nutritional status was graded with body mass index (BMI), mid upper arm circumference (MUAC) and Subjective Global Assessment (SGA). Nutritional intervention expressed in the percentage of energy, protein, carbohydrate and fat achievement of patients in treatment. We evaluated nutritional status and nutritional interventions on length of stay and clinical outcomes in the form of mortality and conversion time from the patient's PCR swab.

Results: 1726 patients entered the inclusion criteria grouped based on the degree of disease, namely moderate, severe and critical. Assessment of nutritional status using MUAC and BMI had a significant effect on length of stay (P<;0.05), BMI and SGA had significant effect on mortality (P<;0.05). Energy achievement had a significant effect on length of stay, mortality and clinical outcomes (P<;0.05). While, the intake of protein, carbohydrates and fat had an effect on mortality (P<;0.05).

Conclusions: Nutritional Assessment status using MUAC, BMI and SGA in admitted patients can be used as a prognostic predictor of clinical outcome in moderate COVID-19 patients. Nutritional interventions, specifically intake of energy and protein affects the length of stay, mortality and conversion time of COVID-19 patients.

Keywords: COVID-19, nutritional status, nutritional interventions, MUAC, SGA

Conflicts of interests: none

PAB(T2)-62

Comparison of label-declared versus laboratory-analyzed nutrient content values among commercially produced complementary foods sold in Cambodia, Indonesia and Senegal

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Background and objectives: Commercially produced complementary foods (CPCF) are increasingly fed to infants and young children in low- and middle-income countries (LMIC). Given this age group's unique nutritional requirements, it is essential that CPCF accurately report their nutrient content. This study assessed whether CPCF in three urban, peri-urban and rural LMIC settings contained key nutrients in the amounts declared and claimed on product labels.

Methods: A purposive sample of commonly available CPCF (instant cereals, purees/meals, and snacks/finger foods) in Khsach Kandal, Cambodia (n=11); Bandung City, Indonesia (n=11); and Dakar, Senegal (n=21) were sent for blind laboratory-measurement of total fat, saturated fat, protein, carbohydrate, sugar, sodium, calcium, iron, and zinc content. European Union (EU) guidance on nutrient-specific tolerance thresholds was used to assess the label values (LV) and laboratory-measured analytical values (AV) to characterize the accuracy of nutrient content claims and nutrient content information on CPCF labels.

Results: All 11 CPCF from Cambodia failed to meet the EU tolerance range for protein, with protein LV lower than AV. Of products declaring sugar content, half of products (n=4/8) from Indonesia and 40.0% (n=2/5) from Cambodia were noncompliant, with sugar AV higher than LV. Conversely, nearly all (91.7%, n=11/12) of the products from Senegal that declared sugar content on labels were compliant. Four products from Indonesia made a calcium claim, yet all four failed to meet the calcium tolerance range with calcium LV higher than AV. Six products from Indonesia made an iron claim, yet four were noncompliant with the iron tolerance range, half (n=2/4) of which overstated iron content. Most CPCF products (88.4%, n=38) had at least one of the analyzed nutrients missing from the label's nutrient content declaration.

Conclusion: Nutrient declarations on the labels of most CPCF assessed in this study deviated from laboratory-measured values. Caregivers rely on labels to inform them of what nutrients their child receives from a product. Without accurate nutrition information, caregivers' decision-making about young child feeding is compromised. Increased monitoring of declarations of

nutrient content and associated claims, especially for key micronutrients, is recommended to avoid misleading consumers of the true content of CPCF.

Further Collaborators: Elizabeth Zehner

Keywords: commercially produced complementary food, infant and young child nutrition/feeding, food label accuracy, nutrient content

Conflicts of interests: none

PAB(T2)-63

Nutritional composition of packaged foods and non-alcoholic beverages available in Senegalese supermarkets

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Background and objectives: The World Health Organization (WHO) recommends food companies to reformulate their products to limit the content of energy and nutrients of concern (saturated fat, added sugars, and sodium). The purpose of this study was to evaluate, for the first time, the nutritional quality of packaged foods and beverages available in supermarkets in Dakar, Senegal.

Methods: A market survey was conducted between August and September 2021 to collect data from packaged food in the two largest and most popular retailers in Dakar. Nutritional composition and promotional strategies were recorded from the packaging. The food products were divided into permitted or not permitted to be marketed to children using the WHO Nutritional Profiling Model for the African Region.

Results: Overall, 7398 packaged food products were collected and 82% of products providing some nutritional information were analyzed. Levels of nutrients of concern varied considerably across food categories and the majority of them do not meet criteria for energy, fat, total sugars. The most energy-dense foods per 100g were butter (744 kcal), snacks (530 kcal), cookies (473 kcal), confectionery (405 kcal), and breakfast cereals (386 kcal). Those with high saturated fat content were crackers (9.8g), cookies, ice cream (9.1g). Total sugars were higher in desserts (84g), breakfast cereals (73g), confectionery (71g), cookies (66g), and brioche bread (65g). The highest levels of added sugars were observed in chocolate spreads, jams, confectionery (55g), ice creams (26g). High salt content was found in the condiment sauces, including mustard (5.62g), ketchup (2g) and mayonnaise (1.25g). According to the WHO AFRO nutrient profile model, 100% of confectioneries, cakes, cookies, breakfast cereals and ice creams would be prohibited from marketing (levels of total sugars exceeding the thresholds), while 100% of chips and ketchup and 80% of cheese should not be marketed due to excessive levels of fat. Nevertheless, 31% of confectioneries and cookies and 60% of breakfast cereals were promoted on the packaging.

Conclusions: Policy regulation of packaged food should be addressed and strength to support industrial companies to limit the content of nutrient concern in the context of increasing levels of obesity and diet-related NCDs.

Keywords: Food packaged, Nutritional composition, Promotion, Supermarket, Senegal

Conflicts of interests: none

PAB(T2)-64

Relationship between the Dish Based Dietary Patterns and Metabolic Indicators

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Background and objectives: When eating, it is consumed as unit of food, not as a unit of groceries or nutrients. Therefore, this study tried to analyze relationship between their food based dietary patterns and metabolic indicators, to provide the dietary guidelines for preventing and managing metabolic disease such as diabetes, hypertension and dyslipidemia.

Methods: This study used the metabolic indicators and food intake data of men and women aged 30 to 49 in the 6th & 7th Korea National Health and Nutrition Examination Survey. Total of 10,037 persons (men 4,108, women : 5,929) were analyzed with the exception of the persons whose data are insufficient. The metabolic indicator was blood pressure, fasting glucose and serum lipid profile. For the analysis, 24-hour recall was applied for food groups, and consequently 23,174 foods were categorized into 24 food groups. After that, factor analysis was conducted in the satisfaction of over 0.3 communality of food groups. The three patterns were derived both men and women, under the conditions of KMO=0.521 in men, KMO=0.513 in women. For analysis, factor score was divided into quartiles, generalized linear model (GLM) was performed to analyze the relationship between food based dietary patterns and food based dietary patterns.

Results: The study results are as follows: Pattern 1 was grilled, beverages, seasonings, pickles, and vegetables, pattern 2 was rice, kimchi and soup, pattern 3 was dairy products, fruits, and individual foods for men. Pattern 1 was rice, kimchi, soup and food boiled down in soy sauce, pattern 2 was grilled, beverages, pickles, and stew, pattern 3 was dairy products, fruits, and individual foods for women. Both men and women showed a significant decrease in systolic blood pressure (men,Q1:119.4 mmhg, Q4:116.7 mmhg, p<;0.001; women, Q1:109.9 mmhg, Q4:107.3 mmhg, p<;0.001)and triglycerides(men,Q1:205.9 mg/dL, Q4:167.4 mg/dL, p<;0.001; women, Q1:110.4 mg/dL, Q4:98.8 mg/dL, p=0.001) in pattern 3.

Conclusions: A diet pattern with sufficient milk and fruit may help lower blood pressure and blood lipids in Korean adults aged

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

30-49 years.

Further Collaborators: This work was supported by Korea Institute of Planning and Evaluation for Technology in Food, Agriculture and Forestry(IPET) through "Development of personalized diet design platform" Project, funded by Ministry of Agriculture, Food and Rural Affairs(MAFRA)

Keywords: Dietary pattern, Adults, Korean

Conflicts of interests: none

PAB(T2)-65

Lignan intake of plant-based foods in the Netherlands and its relation with obesity indicators

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Background and objectives: The global burden of obesity has profound public health implications in chronic disease onset and a healthy lifespan. An exploration of food patterns that are beneficial in the primary prevention of obesity is warranted. Lignans are biologically active plant-derived compounds with a chemical structure similar to estrogen and have been associated with modulation of energy metabolism with possible effects on weight loss. Lignans may suppress adipose tissue growth, inhibit differentiation of preadipocytes, stimulate lipolysis, and induce apoptosis of existing adipocytes, thus reducing adipose tissue mass. This study aimed to assess whether lignan intake is associated with lower body mass index (BMI) and waist circumference in a Dutch population.

Methods: Data on lignan content of foods was extracted from a lignan database of Dutch plant based foods and complemented with three other references to estimate lignan intake in 1012 Dutch men and women participating in the NQ-plus prospective cohort study. The association between lignan intake and BMI and waist circumference was assessed using linear regression analysis. Three multivariate models were used to investigate the association of BMI and waist circumference with total lignan intake. Model 1 included adjustments for lifestyle variables, in model 2 adjustments were made for energy intake and nutrients, and in model 3 these adjustment were combined.

Results: The median lignan intake was 3226 µg/day (mean 4763 µg/day, SD 5386 µg/day). The median BMI was 25.2 kg/m2 (IQR 23.1 – 28.0) and waist circumference was 90.5 cm (IQR 82.7 – 99.0). Lignan intake was strongly skewed towards higher values, ranging from 40-50500 µg/day. The major sources of lignans were bread, which contributed 52%, nuts, seeds, and snacks (21%), and vegetables (12%). After adjustments lignan intake was associated with lower BMI (-0.93 kg/m2 per 1-SD of lignan intake, 95% CI: -0.91; 1.02) and with a lower waist (-0.93 cm, 95 % CI: -0.88; -1.00).

Conclusions: A higher lignan intake is significantly associated with a smaller waist circumference in Dutch adults. To what extent a high lignan intake can reduce waist circumference in obese patients or can prevent onset of abdominal obesity remains to be tested in future intervention studies.

Keywords: lignan intake, body mass index, waist circumference, plant-based food, NQ-Plus data

Conflicts of interests: none

PAB(T2)-66

Estimation of dietary iron bioavailability from total iron intake and iron status of Filipino adolescents living in a rural area

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Background and objectives: Iron reference values are essential for assessing adequacy of iron intake. Among Filipino adolescents, a large inconsistency exists between the reported prevalence of anemia (7.7%) and iron deficiency (9.6%), and their inadequacy of iron intake (87–97%), which may be related to the underestimation of iron bioavailability from the diet. We aimed to explain this discrepancy by estimating the average iron absorption required to maintain iron status with current dietary iron intake in Filipino adolescents living in a rural area as part of the Ten2Twenty project in the Philippines.

Methods: A total of 195 Filipino adolescents were included and stratified by sex (boys, n=97; girls, n=98) and menarche status (pre-menarche, n=43; post-menarche, n=55). A probabilistic model was applied using total dietary iron intake based on two non-consecutive 24h-recalls against physiological iron requirements to estimate the prevalence of iron inadequacy along a scale of 1–40% bioavailability. Subsequently, the cumulative distribution of inflammation-adjusted serum ferritin (SF) concentrations was calculated for each sub-group, providing the group-specific prevalence of iron deficiency. Iron bioavailability was estimated by matching the prevalence of iron inadequacy with the observed prevalence of iron deficiency for each group, assuming that these were equal.

Results: Overall, the prevalence of anemia was 19%. Median total iron intake and SF concentrations were 9.99 mg/d and 82.4 µg/L in boys, 9.49 mg/d and 73.7 µg/L in pre-menarche girls and 10.1mg/d and 58.4µg/L in post-menarche girls. The corresponding predicted iron bioavailability values in boys, pre-menarche girls and post-menarche girls, were 13%, 11% and 15%, respectively, which is higher than the currently assumed bioavailability value of 8.5%. The overall prevalence of iron inadequacy decreased markedly from 77% to 43% after applying the modeled bioavailability predictions.

Conclusions: We found evidence that the discrepancy between a high inadequacy of dietary iron intake and a mild prevalence of anemia can be partially explained by underestimation of the current iron bioavailability value. However, methodological uncertainties by unstable iron status due to growth and the onset of menstruation during adolescence

should be further investigated. [Conflict of Interest Disclosure] The data used for this study originated from the Ten2Twenty Philippines Project, which received support from a company that markets and sells micronutrient supplements in the form of hygienic products, which was given as part of tokens received by the study participants.

Keywords: Iron intake, Serum Ferritin, Bioavailability, Filipino, Adolescents

Conflicts of interests: none

PAB(T2)-67

Solanum Torvum Consumption as a means of improving heamogloblin levels in pregnancy, a facility-based study of pregnant women attending antenatal services in the Cape Coast Metropolis, Ghana.

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Background and objective: Anaemia in pregnancy constitutes a significant public health and developmental concern globally. Women in West Africa and Ghana commonly use Solanum torvum as one of the means of improving the haemoglobin levels during pregnancy. This study aimed at assessing the consuption of Solanum torvum in pregnancy and haemoglobin levels of pregnant women.

Methods: This was a facility based prospective study that targeted women in their first trimester of pregnancy. Using a purposive sampling procedure, data was collected from 211 consented women on their socio-demographic characteristics, dietary diversity scores, Solanum torvum consumption patterns, and haemoglobin measures of respondents. Both descriptive and inferential analysis using probit regression and a paired sample t-test were conducted.

Results: Approximately 98.5% of the women indicated ever-using solanum torvum preparation. The predictors were essentially their background characteristics, including age, marital status and educational attainment. The differences in haemoglobin levels between phase 1 and phase 2 and those who took the special preparation of solanum and those who did not was not statistically significant.

Conclusion: The result suggest no effect of the special preparation of solanum torvum intake on heamglobin levels of pregnant women. However, its use in daily diet is recommended.

Further Collaborators: The Directorate of Research and Innovation, University of Cape Coast that supported the work.Research Assistants: Brigette Agbesi, Enoch Mensah, Blessed Esson and Annegrette Elizabeth Agyapong Staff and leadership of the University of Cape Coast, maternity block

Keywords: Solanum torvum, Pregnant women, Consumption, heamoglobin, dietary diversity

Conflicts of interests: none

PAB(T2)-68

Inclusion of nutrient status performance indicators in diet optimisation modelling: a case study of dietary iron intake optimisation and recuperation from anaemia in Nigerian women

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Background and objective: Diet optimisation models are frequently used to evaluate effects of diet modifications on adequacy of nutrient intake. So far, diet models have only used total nutrient intake performance indicators as an outcome, without taking changes in nutrient status and bioavailability into account. We aimed to evaluate the feasibility of including iron status performance indicators in diet modelling, and to use this to predict the required time span to recuperate from anaemia, thereby accounting for changes in bioavailability over time.

Methods: Data from the Nigerian Household Consumption and Expenditures Surveys (2015/2016) were used to calculate daily dietary iron intake of women of reproductive age (n=4,042). A uniform distribution of Hb concentrations was randomly applied to the sample population. Bioavailability of non-haem iron (5%) was assumed to increase by +44% in mild anaemia, +75% in moderate anaemia and +100% in severe anaemia. Linear goal programming was applied to optimise diets for iron intake in three sequential steps: 1) iron balance model, in which meeting iron requirements was set as a hard constraint; 2) iron recuperation model, in which iron intake was optimised until a Hb concentration of 12 g/dl was reached; and 3) iron status model, for calculating the number of days it would take to reach a non-anaemic state.

Results: Iron balance and recuperation diets could be formulated for 3,350 (69%) women, followed by iron status modelling. On average, it would take 55 days to reach a non-anaemic state when starting from a state of mild anaemia (n=1157), 212 days from moderate anaemia (n=722), and 396 days from severe anaemia (n=29). In the iron recuperation diets, vitamin A intake was reduced, but intake of most other nutrients increased slightly.

Conclusion: We have shown that it is feasible to include iron status performance indicators into diet modelling for optimizing iron intake, while accounting for changes in iron bioavailability over time. Nigerian women can recover from mild anaemia by increasing their dietary iron intake within a reasonable time span, but not from moderate or severe anaemia. This modelling approach can be further refined by taking dietary inhibitors and enhancers into account.

Keywords: Diet modelling, dietary iron intake, Bioavailability, Anaemia, Linear goal programming

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-69

Investigation of Amino Acids and Fatty Acids Profiles of Japanese Diets Using the Food Exchange Chart for Diabetes Diet

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Background and objectives: Diet is an essential part of healthcare, and dietary assessment primarily uses PFC balance in the conventional way. In addition, dietary surveys have been needed objective evaluation methods that do not require interviews. We thought that food metabolomics could be utilized for this purpose. However, there are little information on reference values for basic amino acids (AA) or fatty acids (FA) metabolites. Therefore, we investigated dietary AA and FA profiles as an ideal diet of Diabetes Mellitus (DM) exchange menu for Japanese.

Methods: Eighteen AA and forty-nine FA in DM menu for 15 days. It has three types of carbohydrate rates with 60 % (HC), 55 % (MC), and 50 % (LC). From 1200 to 2000 kcal/day menus were calculated by the Japanese Food Composition Table 2020 7th, which differences in energy were corrected by dividing by 1000 kcal. AA and FA mg/1000kcal and calorie density (CD) g/kcal were compared among the three groups.

Results: AA in HC, MC, and LC were 42.9, 47.6, and 45.6 mg/1000 kcal, with no significant differences among the three groups. FA in HC, MC, and LC were 20.1, 23.7, and 28.0 mg/1000 kcal, respectively. FA of MUFA, PUFA, and n-6 PUFA in LC was significantly higher than those in HC. The 18:1 total, 16:0, and 18:2 n-6 had higher FA values in that order. The 18:1 total was accounting for 35.3 % of the total FA. The 16:0, 20:0, and 18:1 total in LC had significantly higher than those in HC, while 22:0 and 18:3 n-3 in MC had significantly higher than those in HC. CD in HC, MC, and LC were 0.82, 0.84, 0.93 kcal/g, respectively, which showed low-calorie density. There were no significant differences in CD among the three groups.

Conclusions: There were no significant differences in the 18 amino acids among the menu items, suggesting that differences occur in fatty acids. These data are useful for the ideal value of Japanese Diet and a new evaluation for meals of food metabolomics.

Keywords: Japanese diet, amino acid, fatty acid, food metabolomics, nutritional test

Conflicts of interests: none

PAB(T2)-70

Comparison of blood sampling techniques for hemoglobin measurement: Results from The Demographic Health Survey Program pilot

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Background and objectives: Standard practice for estimating anemia in population-based surveys is to use a single drop of capillary blood and measure the hemoglobin (Hb) concentration on a point-of-care device. Emerging evidence points to larger than expected differences in Hb concentration depending on the blood sample technique used. We evaluated use of different blood sources to measure Hb on a HemoCue 201+ compared to the gold standard of venous blood on a hematology analyzer.

Methods: Hb concentration from a single capillary blood drop, pooled capillary blood, and venous blood were collected in a controlled (laboratory) and field setting (DHS-8 pilot) among non-pregnant women 15-49 and children 6-59 months in Uganda. Hb concentration was measured in capillary and venous blood using a HemoCue 201+ and the venous blood was also measured on a Sysmex XN-450 hematology analyzer. Agreement was estimated using Lin's concordance correlation coefficient, Bland-Altman plots, and Deming regression. Means and prevalences were compared across groups using paired t-tests and McNemar's tests, respectively.

Results: The correlation between blood measured using a HemoCue 201+ against the gold standard was the highest for venous blood (0.89-0.97), followed by pooled capillary blood (0.81- 0.91), and single drop capillary blood (0.76-0.88). Bland-Altman plots indicated no bias for any comparators. The absolute mean difference in Hb was lower than 0.5 g/dL for all comparators. There were no differences in mean or prevalence estimates between venous blood and the gold standard except among women in the controlled setting but there were non-clinically relevant statistically significant differences in means from both types of capillary blood. This translated into a statistically significant difference in anemia estimates for pooled capillary blood among children (controlled and field setting) and women (controlled setting) compared to the gold standard.

Conclusion: Venous blood samples measured by the point-of-care HemoCue 201+ and the gold standard method were similar. While there was good agreement between capillary blood measured using the HemoCue 201+ and the gold standard, capillary Hb variability was higher than venous blood. Further work is needed to evaluate the implications of using venous versus capillary blood to measure Hb in population-based surveys.

Keywords: anemia, demographic and health surveys, capillary, hemoglobin, venous

Conflicts of interests: none

PAB(T2)-71

A prudent Japanese dietary pattern is associated with a reduced risk of metabolic diseases predicted by principal component analysis of the clinical parameters related to metabolic syndrome

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Background and objectives: Dietary quality is related with the prevalence of metabolic disorders worldwide, and its application to dietary practice is expected. In this study, we have explored a dietary pattern, the score of which is associated with reduced risks of metabolic disorders in community dwelling people in Japan.

Methods: A cross-sectional survey including 5,025 healthy Japanese men (aged 40-64 years) who participated in health checkups was conducted in Shizuoka, Japan. We analyzed their dietary habits and food intake using a brief-type self-administered diet history questionnaire (BDHQ), and the dietary patterns were identified by factor analysis. We assessed the risk of metabolic diseases using principal component (PC) analysis of the clinical parameters including body mass index, blood pressure, triacylglycerol, HDL-cholesterol, and fasting blood glucose. We compared the relationship between the score of a prudent Japanese dietary pattern and the PC1 score calculated from the parameters strongly associated with metabolic syndrome.

Results: Factor analysis of dietary habits and food intakes showed that the major factor (factor 1) accounting for their dietary pattern was closely related with the intakes of vegetables, mushroom, see weeds, soy products, potato, fruits, and fish, which suggests “a prudent Japanese dietary pattern” with a variety of food in the meals. The score of the prudent Japanese dietary pattern was associated with lower PC1 score, and it was also associated with a lower level of γ-GTP. The group of higher PC1 score showed significantly less intakes of vegetables, see weeds, soy products and potatoes, along with a lower score of the prudent Japanese dietary pattern than other groups.

Conclusions: The results of this study indicate that a prudent Japanese dietary pattern is associated with a reduced risk of metabolic diseases in community dwelling Japanese people.

Keywords: dietary pattern, factor analysis, metabolic diseases, principal component analysis

Conflicts of interests: none

PAB(T2)-72

Estimating minimum dietary diversity for children 6 to 23 months of age: a comparison of two dietary recall methods to an observation of dietary intake

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Background and objectives: Dietary intake in large-scale surveys is often assessed using a 24-hour dietary recall using an open, list-based, or a hybrid method involving both open and list-based dietary recalls. A recent study comparing list-based and open recall methods against weighed food records [WFR] to assess minimum dietary diversity in women of reproductive age [MDD-W] showed similar differences in accuracy; list-based and open recall methods overreported women achieving MDD-W by 16 and 10 percentage points, respectively, as compared to WFR. It is not known if minimum dietary diversity [MDD] in children 6 to 23 months calculated from different dietary recall methods is comparable or which method is most accurate. The aim of this study is to compare estimations of the MDD indicator from a list-based method and a hybrid method with an observation of dietary intake in representative samples of children 6 to 23 months of age (participants) in USAID Feed the Future Zones of Influence (geographic areas where programming is targeted) in Cambodia and Zambia.

Methods: Data in both countries will be collected in May 2022. Data for each participant will be collected over two consecutive days. On Day 1, a participants' food intake will be observed for an entire day and recorded. On Day 2, the participants' primary caregivers (respondents) will be interviewed twice (once in the morning, once in the afternoon), to recall the participants' dietary intake from Day 1 using a list-based and a hybrid method, with random order assignment. The MDD indicator will be estimated three times—based on the observation on Day 1 and the two interviews on Day 2. Observed (Day 1) or reported (Day 2) foods will be grouped into sub-food groups, which will be collapsed into eight defined food groups. MDD will be calculated as achieved when foods and beverages from at least five out of eight defined food groups were reportedly consumed (WHO and UNICEF, 2021).

Results: Preliminary results will be available in July 2022.

Conclusions: The findings will contribute evidence to optimize MDD assessment in population-based surveys.

Keywords: diet quality, minimum dietary diversity, IYCF, dietary recalls

Conflicts of interests: none

PAB(T2)-73

The relationship between sex, eating disorders, stress levels, food habits, and parent's income with nutritional status of health sciences undergraduate students x university in Indonesia during pandemic Covid-19 year 2022

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Background and objectives: Nutritional status is a condition in the human body that can be seen from food and the use of nutrients consumed in the body. The 2018 Indonesia Basic Health Survey found the prevalence of overweight in adolescents aged over 18 years has increased from year to year, namely in 2007 as much as 8.6% however in 2013 as much as 11.5% and in 2018 by 13.7% (RISKESDAS, 2018). During adolescence, there is rapid growth and development, both physically, psychologically, hormonally, and intellectually. The obvious changes are physical growth and development that will affect nutritional status. Therefore, at this age period, adolescents are vulnerable to nutritional problems. Nutritional status is a state of the body that is influenced by food intake and the use of nutrients consumed in the body. Some of the indirect causes of nutritional problems related to body image, eating disorders and stress levels. University students tend to have poor eating practices which is related to nutritional status. The aimed of this study to determine nutrition status determinants among undergraduate students X University at Jakarta in Indonesia.

Methods: We used cross sectional design. The subject of the study were 267 students aged 17-21 years old in 2022. The data for this study were anthropometric data, body image, eating disorders, stress levels, food habits, media exposure, physical activity, parental education, parental income and nutritional knowledge Fischer's exact test was used to compare the categorical variables. Statistical significance was set at p <; 0.05. We used chi square for bivariate analysis and for multivariate analysis we used logistics regression.

Results: The bivariate analysis reported a significant association between sex, eating disorders, stress levels, food habits, and parent's income with nutritional status. Based on logistic regression, the odds of having nutritional status is about 2.5 times higher among students whose the poor food habits.

Conclusions: The poor food habits are a major factor in nutritional status problems. Therefore, nutritional and public health intervention to prevent adolescent nutritional problems. Keywords: eating disorder, food habits, nutritional status, sex, stress level.

Keywords: food habits, nutritional status, stress level, sex, eating disorder

Conflicts of interests: none

PAB(T2)-74

The prevalence of obesity among adolescents between the ages of 10 to 15 years at the University of Ghana basic school.

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Background and objectives: Obesity is a medical disorder characterized by the excessive deposition or accumulation of fats in the adipose tissues to the point that health is compromised. It is one of today's most visible yet least addressed public health issues. According to the Center for Disease Control, the prevalence of obesity among adolescents has increased over time, with 20.3 percent among 6- to 11-year-olds and 21.2 percent among 12- to 19-year-olds. The objective of this study is to determine the prevalence of obesity and nutritional status of adolescents between the ages of 10 to 15 in the University of Ghana basic school.

Methods: Random and systematic sampling techniques were used in selecting seventy study participants. The background information of the parents of participants were collected. Participants' background information, anthropometric data, level of physical activity, lifestyles, eating habits, dietary intakes (food frequency and 24-hour recall) were assessed. SPSS version 26, WHO anthroplus and West African Food Composition tables were used for analysis. Descriptive and bivariate analyses were used in determining the relationships among variables used.

Results: The prevalence of underweight, normal, overweight and obesity among study participants were 11%, 4%, 15% and 10% respectively. In contrary to previous reports from the same population, the prevalence of obesity was higher in males (6%) than in females (4%). Most of the participants had moderate physical activity. Females recorded slightly higher moderate physical activity (53%) than their male counter parts (36.7%) even though this was not significant (p-value=0.422). Most of the respondents were sedentary (90%) and 10% were physically active. Out of eighteen food groups, respondents had an adequate dietary diversity score of 7.68±1.36. Only 38.6% and 27.1% of respondents were overweight and obese respectively. There was no significant relationship between obesity and physical activity (p-value =0.622). Also, there was no significant relationship between dietary diversity and physical activity (p value=0.207) and between BMI status and physical activity (p value=0.622).

Conclusions: This study revealed that the prevalence of obesity among participants was higher in males than females with percentages of 6% and 4% respectively.

Keywords: Obesity, Dietary diversity, Nutritional assessment, Sedentary lifestyle, Adolescents

Conflicts of interests: none

PAB(T2)-75

Ultra-processed foods and human health: reliability and validity of a novel measure PIE score to assess processed food intake in adolescents

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Background and objectives: This paper describes the development of a novel measure- Processed Intake Evaluation score (PIE score) for use with adolescents to measure processed food intake. Adolescent intake of ultra-processed food now comprises 67% of their diet. (Wang, et al., 2021). Due to this, there has been an interest in new approaches to assess processed food eating behavior.

Methods: To examine PIE score in comparison to controls, we collected data for 215 participants, aged 13–19 years, in Florida. PIE score was calculated for each participant to assess overall consumption of ultra-processed foods including Cookies, Candy, Chips, Chocolate, Energy drinks, Frozen desserts, Processed Meat, Protein bars, Soda, Sports drinks, Store pastries, Store smoothies, Sweetened tea or coffee, and White bread.

Results: The participants' mean age was 16.2 ± 1.1 years with 57% (n = 122) females. All a priori predictions regarding associations of PIE score with measures like subset DINE score (Roe, et al., 1994) were supported at high significance indicating good convergent validity. The median PIE score was 37.5 (scale 0-100). PIE scores were higher (p<;0.01) for participants who eat dinner watching TV (45.5 vs 33.8), eat dinner browsing smartphone (44.1 vs 33.7), don't read nutritional labels (43.0 vs 35.8), don't consider protein content (42 vs 35.1), have parents who don't put hard limits on some foods (40.4 vs 31.6), and have parents who tell participants they "must finish everything on plate" (44.2 vs 35.6). Participants linking food and emotion also had higher PIE scores (p<;0.01) if they eat food when angry (65.9 vs 36.0), sad (47.6 vs 35.34), anxious (46.7 vs 34.9), or guilty (53.9 vs 36.8).

Conclusions: The development of PIE score, designed specifically to measure processed food eating habits in adolescents, gives it an advantage over standard food-groups or nutrient-questionnaires in assessing processed food intake. The resulting instrument has a high level of internal and test-retest reliability. Understanding underlying factors leading to an unhealthy processed diet and higher PIE scores is key to addressing improper nutrition knowledge, attitudes, and health outcomes earlier through outreach programs.

Keywords: Nutrition, Nutritional Assessment, Adolescents, Processed Food, Eating behavior

Conflicts of interests: none

PAB(T2)-76

Proximate analysis of rice bean (vigna umbellata) isocaloric diet for sprague-dawley rat biossay

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Background and objective: Protein intake is an essential component of adequate diet due to its physiological functions for growth and development. Alternative protein source from indigenous legumes such as the rice bean (Vigna umbellata) has potentials in alleviating food insecurity especially among families with low income in the Philippines. Hence, as part of the methods of protein efficiency ratio to evaluate the quality of dietary protein in rice bean; this study aims to determine the moisture, crude protein, crude lipid, and carbohydrate content of rice bean diet which will be used as test protein in a Sprague-Dawley Rat Biossay.

Methods: The rice bean isocaloric diet was made in accordance with the Association of the Official Analytical Chemist (AOAC) diet formulation method. The moisture content of the rice bean diet was determined through a moisture analyzer; the crude protein was determined by Kjeldahl method; the crude lipid was determined by Soxhlet method; and the carbohydrate content by difference method. All procedures of the study were reviewed by the Institutional Care Committee of the National Institutes of Health-University of the Philippines Manila in accordance with the Guidelines and Policies on Animal Care and Use.

Results: The study findings showed that the proximate analysis of the rice bean isocaloric diet were the following: moisture content was 10.99%, crude fat was 11.28%, crude protein was 9.89%, and carbohydrate content was 67.83%.

Conclusion: With reference to the composition of diet based on AOAC diet formulation, the proximate analysis of the rice bean isocaloric diet, the test protein for Sprague-Dawley rat bioassay, is within the recommended dietary level, especially the protein content which should be within 10-12% in average.

Keywords: Rice Bean, Proximate Analysis, Sprague-Dawley Rat Bioassay, Protein Efficiency Ratio, Isocaloric Diet

Conflicts of interests: none

PAB(T2)-77

A food frequency questionnaire is a valid tool for the assessment of dietary nutrient intake of Sri Lankan pregnant women

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Background and objectives: Food Frequency Questionnaires have been shown to be an appropriate method for assessing diet. If FFQ can be accessible quantitatively, dietary habits, as well as dietary nutrient intake, can be assessed. This study aimed to develop and validate a Semi-Quantitative Food Frequency Questionnaire (SQFFQ) for Sri Lankan pregnant women.

Methods: Commonly consumed foods were identified by conducting focus-group discussions, and household observations including foods in home gardens. For each food item, the subjects were asked to specify their frequency of intake over a day, week, month, and year. "Never" and "rarely" were included. The portion sizes were estimated by using the portion sizes showing pictorial food albums and common household measures. One hundred four pregnant women attended the maternal clinics in Jaffna and Pannala areas were participated in the validation of the developed SQFFQ. Three-day Diet Diary (DD), including instructions to fill consumed foods with portion sizes, was used to validate the developed SQFFQ. Selected nutrients intake from the diet was collected by using developed SQFFQ and 3-day DD separately from each individual.

Results: The developed SQFFQ consisted of 113 food items. Mean daily energy and selected nutrients intake obtained from SQFFQ was higher than the 3-day DD. Pearson Correlation coefficients between energy and nutrient intake estimated using SQFFQs and 3-day DD ranged from 0.36 for protein to 0.53 for calcium. When adjusting for energy, the correlation was decreased for most of the nutrients except for fat. Cross classification analysis revealed that on average 87% of participants were classified into the same or adjacent quartile of energy, protein, calcium, and folic acid intake when comparing data obtained from SQFFQ and 3-day DD. According to Cohen's weighted kappa values, energy, protein, calcium and folic acid showed relatively fair agreement between these two dietary assessment tools.

Conclusion: The developed SFFQ has adequate validity for assessing the energy, protein, calcium, and folic acid intake of pregnant women in selected areas in Sri Lanka and it may potentially be useful in identifying women at risk for nutrient deficiency in pregnancy.

Keywords: Dietary nutrient intake, Development, Semi-Quantitative Food Frequency Questionnaire, Pregnant women, validation

Conflicts of interests: none

PAB(T2)-78

Most wheat and maize flour brands are fortified but not always with recommended iron compound and iron and zinc quantity: Findings from a market assessment in 2 states of Mexico

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Background and objectives: Fortification of wheat and nixtamalized maize flour with iron, zinc, and B vitamins has been mandated in Mexico since the early 2000s, but micronutrient deficiency, particularly iron-deficiency anemia, remains high. To verify consumers benefit from flour fortification, we assessed (1) the wheat and maize flour brands available in 2 different states of Mexico and (2) the extent to which they meet national flour standards in terms of the micronutrient content and type of compound added.

Methods: We collected data in 2018 on all packaged wheat and nixtamalized maize flour brand products available in different retail outlets in a rural (Chiapas) and urban (Mexico City) state and recorded the added iron compounds indicated on the label. We collected samples of multiple batches of each identified flour brand and assessed added iron using a qualitative test (AACC Method 40-40). Fortified samples were composited by brand product, and the average iron and zinc levels quantified using the atomic absorption spectroscopy and compared to the Mexican standard.

Results: Of the 40 packaged wheat flour and 21 maize flour brands identified, 90% of the wheat and all maize flour were labelled as fortified, while 78% of the wheat and 24% of the maize flour indicated the addition of a recommended iron compound (ferrous salts). A qualitative iron test confirmed fortification of 93% of the wheat and of the 86% maize flour brands and quantitative tests showed 68% of wheat and 67% of maize flour brands met mandated minimum iron and zinc content, but 60% of wheat and only 10% of maize flour brands met the standard levels using a recommended iron compound.

Conclusions: Most packaged flour products are fortified but the effectiveness of the flour fortification program may be compromised due to several producers using iron compounds with lower bioavailability (electrolytic iron) than those recommended by the Mexican standard or international WHO guidelines and the average iron and zinc content of many products not meeting the standard minimum. These study results were used in an elaborate advocacy campaign to influence the government to conduct robust monitoring and enforcement of the Mexican Official Standard NOM-247-SSA1-2008 and hold industry accountable.

Keywords: food fortification, market assessment, Mexico, bioavailability, advocacy

Conflicts of interests: none

PAB(T2)-79

Elderly dietary index in relation with frailty in free-living elderly of Tehran, Iran

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Background and objectives: Frailty is a common clinical syndrome in elderly that carries an increased risk for poor health outcomes including falls, incident disability, hospitalization, and mortality. Frailty is strongly correlated with the dietary intake status. This study aimed to investigate the relation of elderly dietary index (EDI) with frailty phenotype in free-living elderly of Tehran, Iran.

Methods: In this cross-sectional study, 334 elderly (157 women and 177men) aged ≧60 years living in Tehran city were selected using a systematic cluster sampling method. Dietary intake was measured by a validated 168-item semi-quantitative food frequency questionnaire. EDI was calculated by scoring nine components (including questions on the frequency consumption of meat, fish, fruits, vegetables, grains, legumes, olive oil, and the type of bread and dairy products) according to the Modified MyPyramid for Older Adults and selected features of the traditional Mediterranean diet. Fertility was measured using the five indicators suggested by Fried et al., including: 1) slow walking speed 2) muscle weakness (assessed by a hand-dynamometer) 3)fatigue 4)low physical activity, and 5)unintentional weight loss. Total score of 1 or 2 indicated moderate risk for adverse outcomes (prefrailty) and scores of 3–5 indicated frailty Logistic regression was used to investigated the chance of prefrailty/frailty across tertiles of EDI score.

Results: Mean±SD of participants` age was 71.2±7.35 years. EDI score was 29.2±2.2 and was not significantly different between men and women. About half [169(50.6%)] and a quarter of [85(25.4%)] participants were prefrail and frail, respectively. The prevalence of frailty was higher in ages ≧75 years and was higher in women compared to men [51 (32.5%) vs 34 (19.2%)](p-value<;0.05). Also, the frequency of low muscle strength was significantly higher in women than men [58 (36.9%) v.s 8(4.5%)] (p-value<;0.001). After adjusting for confounders, those at the highest tertile of EDI score had lower chance of being prefrail or frail (OR=0.76; 95%CI=0.63-0.91). Across components of EDI, higher legumes score was related with the lower chance of prefrail/frailty (OR=0.69; 95%CI=0.40-0.84).

Conclusion: Higher diet quality of free-living elderly can be a protective factor against prefrailty and frailty. Also, higher intake of plant protein sources was preservative.

Keywords: Elderly dietary index, Frailty, Free-living elderly, Tehran

Conflicts of interests: none

PAB(T2)-80

The impact of recipe disaggregation in the dietary surveys: results from a national food consumption survey in Saint Kitts and Nevis

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Background and objectives: When assessing dietary intakes, individuals may report the consumption of single foods and beverages but also complex dishes or recipes. Although seen as necessary, it is not always the case that recipe disaggregation is performed in dietary surveys, and currently, no standardised methodology is available. This can potentially impact the amounts of reported food items and food grouping, and ultimately influence the dietary indicator of interest. The aim of the investigation was to assess the impact of recipe disaggregation in the recent national dietary survey in Saint Kitts and Nevis and provide recommendations for future assessments.

Methods: Data collected in the first National Food Consumption survey in Saint Kitts and Nevis (2020) was used. A total of 1004 individuals provided information on their food intake obtained using 24-hour dietary recalls (24HDR) and 440 recipes were reported. Recipes were reported in single ingredients at the stage of data collection (n=65) but in most cases, a standard recipe without disaggregation was provided by the respondent (n=375). A simple and pragmatic recipe methodology was developed whereby only those recipes reported more than once during the study or those consumed in large amounts (defined as >;=500 grams) would be disaggregated. The procedure of recipe disaggregation comprised nine steps, including identification of recipes, ingredients, quantities, conversion factors, presence of apparent fluid, among others.

Results: 78 standard recipes were disaggregated (21% of recipes). These recipes contributed to 15.2 percent of the total energy intake of the population while the remaining non-disaggregated dishes (n=297) contributed to 12.5 percent. The proportion of consumers across the different food groups increased dramatically for some food groups after recipe disaggregation, with the most remarkable difference for fats (6.9% before and 44.5% after), pulses (18.6% before and 49.2% after), and vegetables (49.9% before and 76.6% after). Consequently, the reported intakes were also impacted across the food groups.

Conclusions: Recipes are an important source of food group intakes and their disaggregation should be carefully considered in dietary assessments. The methodology used in this investigation will be further refined in order to provide guidance for future surveys.

Further Collaborators: Dr. U. Ruth Charrondière, Kathryn Cargill-Warner, Dr. Marquitta Webb, Dr. Sa'eed Bawa, and

Debora Letícia Frizzi Silva

Keywords: Nutritional surveys, Recipes, Food consumption, Dietary survey

Conflicts of interests: none

PAB(T2)-81

Validation of Hemocue method for anemia detection and development of a new cut-off to detect anemia in children

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Background: Assessment of Hemoglobin (Hb) by Hemocue has been used widely as a convenient method for anemia screening at population-level surveys. Previous studies showed poor agreement between Hemocue and the direct cyanmethaemoglobin (DCM) method - the diagnostic gold standard for Hb assessment resulting in underestimation of anemia prevalence by Hemocue. This study aims to validate Hemocue with the direct cyanmethaemoglobin method and to develop a new cut-off to detect anemia by Hemocue in children.

Methods: This study used Hb data of children under 5 years from an urban slum of Dhaka, Bangladesh. The study used both the Hemocue and the DCM method for Hb assessment using venous blood samples. Hb levels were compared between the assay methods and sensitivity and specificity of Hemocue were calculated. The optimal cut-off of anemia for children by Hemocue method was estimated based on Youden's index in receiver operating characteristic (ROC) analysis and it was validated by Train/Test method, where data set was split into two: training dataset (70%) and testing dataset (30%).

Results: The mean Hb concentrations for 1216 venous blood samples estimated by Hemocue and the DCM were 11.80 ± 1.50 g/dL and 10.97 ± 1.38 g/dL, respectively. Using the cut-off of <; 11 g/dL for anemia, anemia prevalence was significantly higher in DCM method (DCM vs. Hemocue, 48.6% vs. 28.3%; p<;0.05). Considering DCM as the gold standard, the sensitivity and specificity of Hemocue method were 53% and 95%, respectively. ROC analysis has identified an optimal cut-off of 11.7 g/dL for anemia in children which has an area under the curve (AUC): 85%, sensitivity: 76%, and specificity: 82%. In the test/train method, by using the new cutoff of 11.7 g/dL identified from the training data set, the testing data set showed the prevalence of anemia is 45.3% with a sensitivity of 74.6% and specificity of 80%. Conclusion Hemocue method has low sensitivity to detect anemia resulting in a grossly underestimated anemia burden. A new cut-off of 11.7 g/dL to detect anemia in children <;5 years can be used for the Hemocue.

Keywords: Anemia, Hemocue, Direct cyanmethaemoglobin, ROC, Bangladesh

Conflicts of interests: none

PAB(T2)-82

Determinants of malnutrition among children aged 6-59 months in the Buea health district, Cameroon

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Background: Malnutrition is a major cause of morbidity and mortality in children under-five. According to the 2011 Demographic and Health Survey, 5.6% of Cameroonian children are malnourished, with 1.9% of them being severely malnourished. This burden varies across the country, and is most felt in areas plagued with ongoing humanitarian crisis, such as the Southwest region. Data on the burden of malnutrition in the Southwest region is sparse. As such, we set out to determine the prevalence and risk factors of malnutrition among children under-five.

Methods: This was a community based cross-sectional study. Children under-five-carer pairs were sampled from households. Households surveyed were selected using a multistage randomized cluster sampling method. Dietary diversity and household food insecurity were assessed using standardized questionnaires. Characteristics associated with malnutrition were obtained using multivariate logistic regression, adjusting for potential confounders.

Results: A total of 321 children (52.3% female) with a mean age of 33.6 ± 16.5 months, and their carers (94.6% female, mean age 30.1 ± 7.7 years) were retained for the analysis. Of the 321 children, 65.1% had a diverse diet with dietary diversity Score more than 4). The prevalence of household food insecurity was 73.9% (10.0% mild, 38.3% moderate, and 25.6% severe). The prevalence of stunting, underweight and wasting were 26.5% 1.6% and 3.7% respectively. Not schooling (OR: 2.33, 95% CI: 1.13 – 4.82); drinking water from inappropriate sources (OR: 2.32, 95% CI: 1.30 – 4.15) and a Dietary Diversity Score <; 4 (OR: 2.59, 95% CI: 1.46 – 4.61) were associated with increased risk of stunting. Children of the male sex were more likely to be wasted (OR: 5.34, 95% CI: 1.09 – 26.14).

Conclusion: Household food insecurity is high in the Buea Health District. Poor dietary diversity and inappropriate drinking water were potentially modifiable, risk factors of malnutrition identified, highlighting the need to develop and strengthen existing interventions aimed at: improving access to safe drinking water within the study area; educating carers of children on the importance of dietary diversity, water, sanitation and hygiene for the proper growth and development of their children.

Keywords: Predictors, Malnutrition, Household food security, Children 6-59 months

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-83

Alterations of antioxidant enzyme activities vitamin A and E status in type 2 diabetic Thai patients

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Background and objectives: Type 2 diabetes (T2D) is one of the metabolic disorders causing 4.2 million deaths worldwide. There are several controversies and limited information about antioxidant defenses and diabetes. In general, increasing production of free radicals and decreasing in antioxidant defense system were considered to cause high blood glucose levels by resisting of insulin hormone in the pancreas. Some studies reported that high levels of antioxidant enzymes were detected in T2D patients. However, few studies have focused on antioxidant vitamins. Therefore, the aim of this study was to investigate the associations of antioxidant enzyme activity including superoxide dismutase (SOD) and catalase (CAT), and vitamin levels consisting of vitamin A and vitamin E in T2D Thai patients.

Methods: The T2D (n=48) and nondiabetic participants (n=56) were included in this study. Blood samples of all participants were determined for SOD, CAT, vitamin A and vitamin E levels.

Results: The results presented that both SOD and CAT antioxidant enzyme activities in T2D group were significantly lower than the control group [odds ratio (OR), 4.31; 95% confidence interval (CI), 1.14-16.30 and OR, 3.57; 95% CI, 1.14-11.18, respectively]. However, there was no significantly statistical difference on vitamin A and vitamin E levels between two groups. Considering of correlation, there was a moderate positive correlation of vitamin A with vitamin E in T2D participants (r = 0.385; p <; 0.01), whereas there was no association between activities of antioxidant enzymes and antioxidant vitamins levels in this group. Similar in control group, the SOD and vitamin A levels showed a weak positive correlation (r = 0.273; p <; 0.05), but there was no correlation of the other parameters presented in this group.

Conclusions: The results suggested that the reduction of antioxidant enzymes activities such as SOD and CAT provides the useful information on prediction of the risk of T2D progression and various complications. These enzymes could be used as the possible parameter to indicate oxidative stress status/ level relating to diabetes. Nevertheless, the data on vitamin A and vitamin E status was not remarkable for this study.

Keywords: Type 2 diabetes, Superoxide Dismutase, Catalase, Vitamin A, Vitamin E

Conflicts of interests: none

PAB(T2)-84

Improving calcium status of women: a study of bio-availability of calcium from slaked lime fortified rice

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Background and Objectives: Fortification of rice with slaked lime is an acceptable and inexpensive way to combat Ca deficiency. However, bioavailability of calcium after intake of slaked lime fortified rice is yet to be investigated. Our objective was to measure the fractional absorption of Ca (FAC) from slaked lime fortified cooked rice.

Methods: We conducted an experimental study using stable isotopes of Ca to measure fractional absorption of Ca during a single morning test meal containing rice fortified with slaked lime. Participants (n=22) were given slaked lime fortified rice three times a day for 4 days. On the morning of the 5th day, the participants were served with the exact amount of rice as previous 4 days at the breakfast test meal with an accurately measured amount of 44Ca stable isotope tracer followed by an intravenous injection of 42Ca. Urine was collected over the next 24 h in 3 consecutive 8-h pools. FAC was measured from the ratio of each administered tracer to 44Ca and 42Ca by using ICP-MS.

Results: The mean dietary Ca from 24-h was 879.5 ± 152.9 µg/g with a coefficient of variance (CV) of 17.2%. Although Ca absorption efficiency decreases during high calcium intake, FAC from test meal using third 8- hr urine pool was 68.8 (CV of 15.15) mg. We found 45.8 (13.06) mg and 70.0 (16.02) mg FAC from the test meal using the first and second 8-h pools.

Conclusions: We showed that one-fifth of daily calcium recommendation could be met by ingesting ~200 mg cooked slake fortified rice.

Keywords: calcium bioavailability, fractional absorption, calcium deficiency, stable isotopes, slaked lime

Conflicts of interests: none

PAB(T2)-85

Evaluation of the test meals and hospital meals by using two mobile food records

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Background and objectives: Mobile food records are currently being used with obese and diabetic patients. There have been papers comparing mobile food records with daily dietary interviews; however, there have been no reports quantitatively assessing actual intake. Here, to test the accuracy of mobile food records, we evaluated the nutritional composition of test meals (ramen noodle soup cup and fruit juice) and hospital meals (Japanese set meal) by using two different mobile food records.

Methods: Eighteen healthy subjects (2 males and 16 females) were enrolled. We used the test meals and hospital meals with the valid information of nutrient contents. We evaluated nutrient contents of these meals by two food record applications, Asken® (Asken Corporation, Tokyo, Japan) and Calomeal® (Life Log Technology, Inc, Tokyo, Japan) over 5 days. A linear mixed model was used to evaluate the effect of meal type, time, age (<;45, >;45 years) on the nutritional composition. Finally, the coefficient of variation (CV) between each parameter was compared using Mann-Whitney U test.

Results: For the test meals, the values measured by two applications were close to the valid values included in the test meals. On the other hand, for the hospital meals, the values measured by the two applications were approximately 1.5 times higher than the valid values in the diet. Furthermore, the mixed model analysis showed that total energy, carbohydrates, and salt were significantly overestimated in the hospital meals. Protein tended to be overestimated, while lipids did not change significantly. Furthermore, total energy and lipids were significantly higher with increasing date. No association with age was observed. Comparison of CVs for each nutrient in the hospital meals indicated that lipids were significantly higher.

Conclusions: In this study, dietary record application of the test meals was very accurate. However, total energy and nutrients of hospital meals may have been overestimated because hospital meals are designed to limit total energy, especially salt and lipids.

Keywords: Mobile food records, Test meal, Hospital meal

Conflicts of interests: none

PAB(T2)-86

Effect of ingestion of cake with resistant starch on preference and postprandial blood glucose levels

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Background and objectives: Prevention of diabetes through daily eating habits is important. Adequate intake of dietary fiber is said to reduce the risk of diabetes. Resistant starch (RS) has a physiological effect similar to that of dietary fiber, such as an effect of suppressing an increase in blood glucose. RS2 has a high amylose content and is used in foods for the purpose of increasing the intake of dietary fiber. Therefore, the performers focused on baked confectionery, which is often taken as a snack in their diet, and measured the GI value of baked confectionery containing RS2. It was examined whether the blood glucose level after ingestion suppresses the increase in the postprandial blood glucose level of healthy subjects as compared with the baked confectionery using normal wheat flour. The preference was examined by a sensory test.

Methods: As the sample, a cake containing 100% wheat flour, a cake containing 60% cornstarch, and a cake containing RS2-containing cornstarch (obtained from J-OIL MILLS,Inc.) were used. The subjects were 15 adults (20 to 22 years old). The test was performed by a randomized crossover method. The subjects ingested a cake was the weight of the dough containing 50 g of carbohydrate. Blood glucose levels were measured before, 15, 30, 45, 60, 90, 120, 150, and 180 min after ingestion. The amount of RS was measured and a sensory test was performed.

Results: As for the increase in postprandial blood glucose level, since the blood glucose increase curve of RS2-containing cornstarch was gentler than that of wheat flour and corn, it is considered that the increase in blood glucose level was suppressed by RS contained in RS2-containing cornstarch. No change in the amount of RS was observed before and after baking. In the sensory evaluation, the average score of RS2-containing cornstarch was lower than that of wheat flour in the items of "fluffy feeling", "moist feeling", and "comprehensive evaluation".

Conclusions: It was confirmed that the cake containing RS2-containing cornstarch had the effect of suppressing the increase in blood glucose level as compared with the cake containing wheat flour and cornstarch.

Keywords: resistant starch, blood glucose levels, GI, IAUC, cake

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-87

Iron deficiency in pregnancy: A secondary data analysis from Vancouver, Canada Kelsey

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Background and objectives: Pregnant women are particularly vulnerable to iron deficiency, given increased requirements to support growth of the uteroplacental organs and fetus. As such, public health guidelines recommend supplementation with an iron-containing prenatal multivitamin throughout pregnancy to meet recommendations of 27 mg elemental iron daily. However, whether supplementation with standard prenatal multivitamins is sufficient to prevent maternal iron deficiency as pregnancy progresses is unclear, as needs increase substantially with advancing gestation. Maternal iron deficiency and anemia are most prevalent in the third trimester, and may result in symptoms of fatigue, hair loss, and irritability (often dismissed as normal symptoms of pregnancy) and have been associated with impaired neonatal growth and neurocognitive development. This study aimed to assess iron status in early and late pregnancy among 60 pregnant women receiving 27 mg/day elemental iron as part of a randomized trial in Vancouver, Canada.

Methods: Study visits were conducted at 8-21 (baseline) and 24-38 (endline) weeks' gestation. Venous blood specimens were collected for a complete blood count and measurement of iron and inflammatory biomarkers. Iron deficiency was defined as inflammation-corrected ferritin <;30 µg/L. Quantile regression was used to explore predictors of endline ferritin concentrations, including ethnicity, education, income, and baseline ferritin.

Results: Overall, n=60 and n=54 women participated in baseline and endline visits, respectively. Rates of iron deficiency at baseline and endline were: n=22 (41%) and n=44 (81%). Ethnicity was the only significant modifier of endline ferritin, with higher concentrations in those of South, East, and Southeast Asian ethnicity compared to European (β=10.4 µg/L, 95% CI=0.3-20.5).

Conclusion: Iron deficiency remains a significant and largely neglected concern among Canadian women during pregnancy. Pregnant women may believe that they are meeting their iron needs throughout gestation by consuming a standard prenatal multivitamin. However, this study provides further evidence that women may require additional or more bioavailable iron to support needs into later pregnancy. Our findings support that the assessment of iron status should be incorporated into routine perinatal clinical practice guidelines to ensure iron deficiency is addressed and that optimal status is maintained throughout all of pregnancy.

Keywords: Pregnancy, Iron, Ferritin, Anemia

Conflicts of interests: none

PAB(T2)-88

Eating behaviour and its association with anthropometric indicators among secondary schoolteachers in Selangor, Malaysia

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Background and objectives: Over the years, the escalating rates of overweight and obesity is becoming a global concern. Malaysian schoolteachers are shown to be vulnerable as their overweight and obesity prevalence surpassed the 2019 National Health and Morbidity Survey (NHMS) which was 30.4% and 19.7%, respectively. Thus, this study aims to evaluate eating behaviour and its association with anthropometric indicators of schoolteachers, representing the working adults' population in Malaysia.

Methods: A cross-sectional study was conducted among 101 schoolteachers from four secondary schools in Selangor, Malaysia, recruited through stratified sampling method. A structured questionnaire consists of socio-demographic characteristics and Dutch Eating Behaviour Questionnaire (DEBQ) was used to obtain the schoolteachers' characteristics. Body mass index (BMI) was determined according to measured height and weight, while waist circumference (WC) was obtained using Lufkin tape W606PD, respectively.

Results: Most of the respondents were female (74.3%), from Malay ethnicity (87.1%), were married (79.2%), with mean age of 40.63 ± 9.39 years and had moderate eating behaviour across all DEBQ subscales. Most of the teachers experienced moderate emotional eating (50.5%), external eating (70.3%) and restrained eating (69.3%) behaviours. The prevalence of overweight and obese were 22.8% and 50.5%, with 23.8% of the teachers having normal weight and a smaller percentage (3.0%) were underweight. Male teachers had higher WC (90.1 ± 13.0cm) as compared to female teachers (86.8 ± 10.4cm). Only emotional eating and restrained eating were significantly associated with BMI, with similar patterns observed with WC of the teachers (p<;0.05).

Conclusions: The schoolteachers in this study experienced varying levels of emotional, external, and restrained eating behaviour and were associated with their anthropometric indicators. Intervention to promote healthy eating behaviour could be conducted to improve overall health and wellbeing, especially among these working adults' population.

Keywords: Eating behaviour, Body mass index, Waist circumference, school teachers

Conflicts of interests: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-89

Increased PTH secretion and Ca absorption rate due to fish bone intake in rats

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Background and objective: Fish-bone, a typical waste in the seafood industry, is a rich in minerals and has high-nutritional value as a potential source of Ca. In this study, we investigated the effects of Alaskan pollock bone, one of the world's largest fish species, on nutritional value and Ca metabolism regulation.

Methods: Alaskan pollock fillets with or without bone (APP-B, APP) were retort-treated and powdered. Ca content of APP-B was 6.16%, which was 58 times higher than that of APP. Male Crl:CD (SD) rats (4 weeks old) were fed four types of experimental diets with different Ca (Total 0.5%) and protein (Total 16.66%) sources for 30 days. (1) Control (AIN-93G): 0.5% CaCO3, 16.66% casein, (2) CaCO3/Casein/APP: 0.49% CaCO3, 10.07% casein, 0.01% Ca and 6.59% protein from APP, (3) Bone Ca/Casein/APP-B: 10.07% casein, 0.5% Ca and 6.59% protein from APP-B, and (4) CaCO3/APP only: 0.48% CaCO3, 0.02% Ca and 16.66% protein from APP. The Ca absorption rate was estimated by measuring the amount of Ca in feces on day 28 of ingestion by ICP-OES analysis. After 30-day ingestion, the aorta plasma was collected to measure plasma Ca, bone formation, and resorption markers (Gla-OC, Glu-OC). Also, we investigated the parathyroid hormone (PTH) in plasma, which modulates blood Ca concentration and participate in bone formation and Ca absorption.

Results: (1) The Ca absorption rate was significantly increased in the APP-B group, indicating that the fish-bone Ca has better absorption characteristics rather than CaCO3. (2) There was no significant difference in plasma Gla-OC and Glu-OC among the four groups, suggesting no marked difference in Ca metabolism between APP-B and CaCO3. These results are consistent with those of herring bone (Fish. Sci., 87, 739, 2021). In addition, (3) PTH secretion increased significantly in the APP-B although no significant differences among the experimental groups in the plasma Ca. Therefore, these results indicate that increased PTH secretion would induce Ca absorption by APP-B.

Conclusion: The ingestion of APP-B stimulates PTH secretion, which induced Ca absorption. Thus, APP-B is the health-beneficial material efficiently absorbed into the body and contributes to maintaining the homeostasis of bone metabolism.

Keywords: Fish bones, Alaskan pollock, Absorption efficiency, Calcium , Parathyroid hormone

Conflicts of interests: none

PAB(T2)-90

Association of zinc and iron status in low-income women of reproductive age in Bangladesh

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Background and objectives: Co-occurrence of zinc and iron deficiencies has been reported in low and middle-income countries, possibly because zinc and iron nutriture share many common dietary sources, bioavailability inhibitors and enhancers, and metabolic pathways. However, literature is limited as to the quantification of the relationship between the indices of zinc and iron nutriture. This study aimed to determine the relationship between zinc and iron status in low-income women of reproductive age in Bangladesh.

Methods: We analyzed data from 1308 non-pregnant, non-lactating women of reproductive age, who participated in a cross-sectional survey conducted in 2021 in purposively selected 10 poverty-stricken rural Mouzas in northern Bangladesh, 3 urban slums in Dhaka, and a readymade garment (RMG) factory in Narayanganj. Concentrations of zinc and ferritin in serum were measured by atomic absorption spectrometry and electrochemiluminescence immunoassay and adjusted for inflammation (CRP and AGP). Zinc deficiency was defined as serum zinc <;66 mcg/dL for blood samples collected in the morning and <;59 mcg/dL for samples obtained in the afternoon. Iron deficiency was defined as serum ferritin <;15 mcg/L.

Results: The study population comprised 458 rural, 351 slum-dwelling, and 499 RMG-worker women. The mean (SD) age and BMI of the women were 28.9 (8.1) years and 22.9 (4.2) kg/m2, respectively. The median (IQR) concentration of serum zinc and ferritin were 62 (57, 68) mcg/dL, and 40.5 (21.7, 71.4) mcg/L, respectively. Of the women, 629 (48.1%) had zinc deficiency, while 195 (14.9%) had iron deficiency. In a multivariable linear regression model with clustered standard errors, adjusted for age, BMI, and blood sample collection time, each log unit increase in serum ferritin concentration was associated with a 0.017 log unit increase in serum zinc concentration (95% CI: 0.005, 0.028; P = 0.009). In a multivariable logistic regression model adjusted for the same covariates, iron deficiency was associated with increased odds of zinc deficiency (OR 1.4, 95% CI: 1.2, 1.6; P <; 0.001).

Conclusions: Depleted iron stores are associated with an increased prevalence of zinc deficiency in low-income women of reproductive age in Bangladesh. Further analyses are required to understand the underlying mechanisms responsible for the association.

Keywords: zinc deficiency, iron deficiency, serum zinc, serum ferritin, survey

Conflicts of interests: none

PAB(T2)-91

Nutritional status of pre-liver transplant patients and predictors of new-onset diabetes after the transplantation

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Background and objectives: Malnutrition before Liver transplantation may increase the risk of complications and affect the success post-operation. New-onset diabetes after liver transplantation (NODAT) is the most common complication in liver recipients and reduces their quality of life. The main objective of the study was to assess nutritional status before liver transplantation and to identify the predictors of new-onset diabetes after liver transplantation (NODAT).

Methods: The retrospective study on 108 adult patients from July 2017 to December 2021 (91.7% male and age 53.6±10.7) has been assigned to the transplantation at the Department of Hepatobiliary Surgery at 108 Military Central Hospital. Eight patients with diabetes before the transplantation were excluded. The nutritional status before liver transplantation was assessed by SGA, BMI, NRI, and biomedical tests. The physician diagnoses the NODAT. Binary regression is used to identify the predictors of NODAT.

Results: The results showed that SGA-C:45.0 %; SGA-B:35.0%; while the risk of malnutrition index showed NRI severe: 10.0%; NRI moderate 43.0%; NRI mild 10.0%. Prevalence of overweight (BMI>;25): 22.0%; low albumin (<;35g/l): 48.0%; anaemia 62%; and 55% had NODAT. Binary regression found age (OR 1.09, 95%CI 1.04 – 1.14), anaemia (OR 0.43, 95%CI 0.19 - 0.99), and blood glucose (OR 1.21, 95%CI 1.01 – 1.47) before the liver transplantation were independent risk factors of NODAT.

Conclusion: The rate of malnutrition risk before the liver operation is very high. Age, anemia, and blood glucose are predictors of NODAT in liver recipients. The caring strategy to improve these factors may reduce the risk of NODAT and enhance the patient's quality of life.

Keywords: Liver transplant, NODAT, Malnutritional, Vietnam

Conflicts of interests: none

PAB(T2)-92

Prevalence of concurrent stunting and wasting among under- five children in Nepal and its association with micronutrients deficiencies.

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Backgrounds and objectives: Micronutrients deficiencies and concurrent stunting and wasting (WaSt) have been prevalent in Nepal especially among the marginalized groups. This study assessed the prevalence and factors associated with the WaSt.

Methods: This study uses data from Nepal Micronutrients survey 2016, a nationally representative cross-sectional study. A total of 4309 households were interviewed using cluster sampling. This analysis used 1462 for the children in analysis with response rate of 85%. Background variables and hemoglobin, ferritin, C-reactive protein (CRP), Retinol Binding Protein (RBP), and Alpha-1 acid glycoprotein (AGP), RBC folate, serum zinc were assessed. The STATA 15 was used to analyze the data. The sample weight was used in order to obtain the national estimates. Multivariate logistic regression was used to assess the factors associated with WaSt considering the complex survey design.

Results: the study revealed the prevalence WaSt was 6% (4.0-7.9) and the odds of WaSt were higher among Terai dwellers compared to Hill dwellers (AOR: 2.84; 95%CI: 1.29-6.25). The odds of WaSt inversely associated with the wealth quintiles, compared to those of bottom quintile the odds of stunting was significantly lower among fourth and richest quintile (p<;0.05). No significant association was observed with age, sex, place of residence, anemia, iron, zinc and folate deficiency, CRP, AGP, ferritin and RBP status with WaSt. The prevalence of stunting or wasting 42% was (37.8-46.7). The odds stunting or wasting increase with increase in age (p<;0.05). The stunting or wasting was significantly lower among female child (AOR: 0.71; 95%CI:0.56-0.89) compared to male counterparts. The stunting or wasting inversely associated with the wealth quintiles (p<;0.05). No significant association was observed with place of residence, ecological zones, anemia, iron, zinc and folate deficiency, CRP, AGP, ferritin and RBP status with either stunting or wasting.

Conclusions: prevalence of WaSt and either stunting or wasting were high among under-five children in Nepal and more prevalent among those who were poor and resides in Terai reasons. Early detection and appropriate treatment of WaSt would be instrumental for child survival. Also, no significant association was observed WaSt and either stunting or wasting and micronutrients status.

Keywords: Micronutrients deficiencies, Stunting, Wasting, Zinc, Ferritin

Conflicts of interests: none

PAB(T2)-93

Fruit and vegetable consumption in urban and rural settings in Ethiopia

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Background and objectives: Though overweight including obesity has multiple behavioural, environmental and genetic risk factors, a low intake of fruits and vegetables is an important risk factor for NCD. We aimed to examine the frequency and adequacy of fruit and vegetables consumptions in the context of

NCD prevention in rural and urban settings in Ethiopia.

Methods: We conducted a community-based comparative survey in urban and in a typical rural setting in Ethiopia. We collected data from a representative sample of 1,152 adults. Fruit and vegetable consumption was assessed based on two different approaches; Quantitatively using 24-hr recall method and qualitatively via the 2017 Behavioural Risk Factor Surveillance System (BRFSS) approach. Respondents were asked consumption of 22 common fruits and vegetables over the previous day. Finally, the intakes were dichotomized into adequate (<; 400g/day) or inadequate (>;=400 g/day).

Results: The study included 1,140 adults and assessed the frequency of consumption of different food groups over the preceding 30 days. In the urban setting, 33.4% and 10.4%; and in rural setting 31.7 and 1.0% of adults consumed whole fruit and 100% fruit juice once per week or more frequently, respectively. Based on frequency of consumption of once per week or more, the most frequently consumed vegetables groups in the urban setting are starchy staples (75.2%), carrots (64.5%), green leafy vegetables (60.9%) and cruciferous (53.4%). On the other hand, in the rural setting green leafy vegetables (92.0%) were the predominating ones. In addition, the median (IQR) total fruit and vegetable intake was 124.0 (15.5-262.3) g/day in the urban setting and 201 (99.6-397.0) g/day in rural setting (p<;0.001). Proportion who consumed 400 g or more were 11.8% in The urban setting and 24.6% in rural setting (p<;0.001). Estimation based on the BRFSS approach suggested 99.7% in urban and 65.2% of the study participants in the rural setting have very low levels of fruit and vegetable intakes (p<;0.001).

Conclusions: Although the WHO/FAO recommend taking 400 or more grams of fruits and vegetables for improving overall health and reducing the risk of certain NCDs, our study showed a very low intake of fruit and vegetables.

Keyword: Fruits, Vegetables, NCDs, Ethiopia

Conflict of Interest Disclosure: Nothing to declare

PAB(T2)-94

Intake of sugar including fructose recorded using a dietary questionnaire in Japanese adults

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Background and objectives: Excessive consumption of sugars (sucrose, fructose, and glucose) is considered a cause of visceral fat accumulation and metabolic syndrome. Few reports on sugar intake in Japan have been published because a comprehensive database on sugar composition was lacking until the publication of a carbohydrate table. “Calorie and Nutrition Diary” (CAND) is a simplified method that allows people who are unfamiliar with recording meals to provide easy answers*. This work was aimed at determining the sugar intake of Japanese adults with a preference for sweet foods and beverages, a habit of snacking, and mild obesity (body mass index [BMI] of ≧23 to <;30).

Methods: In a clinical study for the evaluation of the antiobesity effect of a plant extract (UMIN000042469), participants noted their daily food intake for 3 consecutive days before examination using CAND version 1.0. The examination was conducted at screening and 4, 8, and 12 weeks after the start of intervention in 2021. The intake of the dietary components was defined according to the Standard Tables of Food Composition in Japan 2015 (Seventh Revised Edition) and calculated from the CAND data.

Results: Among the participants, 190 who met the eligibility criteria (91 male and 99 female participants; age, 47.1 ± 10.5 years [mean ± SD]; BMI, 25.7 ± 1.8) participated in the intervention study. Their daily intakes of energy, sucrose, fructose, and glucose for 12 days were 2,690.4 ± 900.1 kcal/day, 45.6 ± 21.8 g/day, 18.8 ± 12.5 g/day, and 18.2 ± 10.3 g/day, respectively. The total sugar intake was approximately 82.7 g/day. Since the participants' daily energy requirement was approximately 1,930 kcal/day, as calculated using the Long method, the total sugar intake was higher than that recommended by the World Health Organization (WHO; less than 10% of energy intake, approximately 50 g/day).

Conclusion: Our results indicate that the sugar intake of a part of the Japanese population exceeds the amount recommended by the WHO.

*__Reference__: Suzuki N, et al. A novel dietary questionnaire: The Calorie and Nutrition Diary (CAND). New Food Industry (Tokyo), 61, 721–731 (2019).

Keywords: Dietary questionnaire, dietary survey, free sugars, fructose consumption, sugar intake

Conflicts of interests: K.S. is employees of Nagaoka Co. Ltd. The sponsor of this study is Nagaoka Co., Ltd.

PAB(T2)-95

Decreased sugar intake due to the increment of conflict-like behavior in consummatory successive negative contrast paradigm: lick microstructure analysis in rats

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Background and objectives: After exposing rats to 32% sucrose for 10 trials but suddenly downshifting the sucrose to 4%, rats will show less intake and number of licks when compared to control animals that have always been exposed to 4% sucrose. This phenomenon is known as the consummatory successive negative contrast effect (cSNC) and is one of the appropriate models presenting how prior taste experience influences food choice. In this study, while focusing on rats' approaching and licking pattern of sucrose solution, we aim to investigate how prior taste experience and its interaction with metabolic needs shape the decision making process in feeding behavior and how this may change over time, using the cSNC

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

model and adopting lick microstructure analysis to measure rats' hedonic state throughout the experiment.

Methods: Rats were assigned to either food-deprived or non-deprived conditions. In each condition, rats were presented with 32% (downshift group) or 4% (unshift control group) sucrose in the 5-minute 10 preshift trials and were all given 4% sucrose in the later 12 postshift trials.

Results: Non-deprived downshift group showed a prolonged suppression of 4% sucrose intake, along with decreased number of licking bursts, an index of motivation level, and the number of access to the drinking spout (entries). Interestingly, deprived animals showed an increase in the number of licking bursts and entries after sucrose downshift. This may be due to the increase in hesitation-like behavior of approaching the drinking spout without ingesting (entry-conflicts), which may have resulted from a conflict between devalued palatability of sucrose stimulus and homeostatic needs to compensate for caloric loss after the downshift of sucrose solution.

Conclusion: From our results, we can conclude that although approaching behavior toward taste stimulus is affected by animals' motivation level, which is modulated by their metabolic needs, actual ingestive behavior may be controlled by factors such as evaluation of tastant. In the evaluation process, the rewarding nature of a taste stimulus may depend not only on its concentration but also on animals' prior taste experience. Such experiences shape subjective evaluation of taste stimulus, influencing the decision making process in feeding behavior.

Keywords: Consummatory Successive Negative Contrast, Lick Microstructure Analysis, Conflict-like Behavior, Deprivation State, Rats

Conflicts of interests: none

PAB(T2)-96

Assessment of the availability of dietary choline-related compounds in vitro and in vivo

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Background and objectives: Choline is a vitamin-like nutrient responsible for various physiological functions, including synthesis of cell membrane phospholipids and acetylcholine. Although choline plays an important role in the body, there are several choline-related compounds in food, and the availability of these choline-related compounds in the body remain unknown. In this study, we used mouse melanoma B16F10 as cancer cells, human dermal fibroblast NHDF and rat skeletal myoblast L6 as normal cells to evaluate the cellular availability of choline-related compounds and also examined the absorption efficiency of choline-related compounds from the intestinal tract in rats.

Methods: The WST-8 method was used to examine the proliferative ability of cells cultured in a choline-deficient medium added by each choline-related compound. For in vivo studies, rats fasted for 16 hours were orally administered GPC or PC, and after a fixed time (0h ,1h ,2h ,4h ,6h), blood was collected from the portal vein, superior mesenteric vein, inferior vena cava and abdominal aorta. LC-MS and LC-MS/MS were used to measure choline-related compounds in cells and serum.

Results: The proliferative capacity of B16F10, NHDF, and L6 was suppressed by choline deficiency, and the addition of Pcho and Cho tended to recover their proliferations, while the addition of GPC showed little effect. In B16F10, the addition of Cho significantly increased the amount of Cho, GPC and lipophilic choline in the cells. In L6, the addition of Pcho and Cho tends to increase the total amount of soluble choline and lipophilic choline. In rats treated with GPC, the concentration of GPC in the portal vein and superior mesenteric vein was maximal after 4 hours, and the amounts of Pcho and Bet also tended to increase slightly.

Conclusions: Choline-related compounds are available as a source of choline in cultured cells, but their availability varies. GPC is absorbed mainly from the small intestine as GPC after approximately 4 hours. The results of the PC-treated rats are currently under investigation and will be reported as well.

Keywords: Choline, Choline-related compounds, B16F10, L6, intestine

Conflicts of interests: none

PAB(T2)-97

Anaemia status and associated factors of anaemia among adolescent girls, pregnant and lactating women in Southern Bangladesh

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Background and objective: Children and women in reproductive years are more susceptible to micronutrient deficiency, particularly anemia. Although iron deficiency is the primary cause of anemia, other factors, such as inadequate dietary intake, micronutrient inadequacy, socio-demographics, and WASH behaviors, may also be involved. The purpose of the study was to evaluate the current anaemia status among adolescent girls (AG), pregnant women (PW), and lactating mothers (LW), as well as the associated factors with anaemia in this population.

Method: In the South-coastal districts of Bangladesh, a cross-sectional survey was carried out utilizing multi-stage cluster-random sampling techniques. AG (10–19 years), PW, and LW were the study population. Local NGOs provided WASH-Nutrition intervention to the participants. WASH initiatives and nutrition education were part of the intervention. There were 375 women in each group, and 400 AG in the sample. Data on socio-demographics, dietary variety, and WASH indicators were gathered. Anaemia was measured by assessing the hemoglobin

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

concentration of capillary blood of the participants. Multiple logistic regression was used to assess the factors associated with anemia.

Results: The average age of women was 24 years and 15.2 years for AG. Half of the PW, 46% of the LW and 37% of the AG were anaemic. Only around 20% of the participants consumed food from more than 5 food groups which suggest poor dietary diversity. Risk of anaemia was 4 times higher among PW who did not wash their hands at least during three critical times compared to those who had proper handwashing practice (AOR: 4.08, 95% CI: 1.7, 9.6, p<;0.001). PW from wealthy quintiles had less risk of anaemia compared to poorest quintile. Middle-aged LW had a higher risk of anaemia compared to younger mothers (AOR: 1.3, 95% CI: 1.1, 1.5, p<;0.005). LW from the middle wealth quintile had less risk compared to the poorest.

Conclusion: The high prevalence of anemia was noticed among all survey participants who needed to get urgent attention. Improved handwashing practice and better asset quintiles reduced the risk of anaemia among women. Nutrition-sensitive or specific intervention is required to improve the dietary diversity among this vulnerable group.

Keywords: Anaemia, Adolescent girls, WASH, Pregnant & lactating Women

Conflicts of interests: none

PAB(T2)-98

The association between health behaviors and Korean Diet Score (KDS) as an index for the balanced diets: KNHANES (2015-2019)

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Background and objectives: In the previous study, we created the Korean Diet Score (KDS) as the index to evaluate the balanced diets or the dietary diversity based on the "Food Balance Wheel" with six classified food categories developed by the Korean Nutrition Society. Furthermore, in this study, the association between health behaviors like "Alamada 7 health habits" and KDS was evaluated, and it will be applied in the "Chronic Diseases Prevention with Health Behaviors-related Quality of Life".

Methods: Based on Korean National Health and Nutrition Examination Survey (2015-2019), healthy adults over 19 years old (n=11,498, men; 3,867 women; 5,258) were our subjects, excluding pregnant/lactating women, under-or overfeeding, patients, and missing data of health behaviors. We used the complex weighted samples with CDC guidelines and ANOVA to analyze health behaviors on KDS and multivariate analysis with extra factors, such as marriage, economics, and education, etc, using the statistic SW, SAS ver. 9.4 (SAS institute Inc, Cary, NC, USA).

Results: KDS was significantly high in adults with health behaviors such as non-smoking, non-skip breakfast, and self-control in eating out without gender differences (p<;0.05). In an older person, KDS was significantly associated with health behaviors such as non-smoking, nondrinking, normal weight, non-skip breakfast in men, but it was high in women with non-skip breakfast behaviors only (p<;0.05). As results of multivariate analysis, nondrinking (β=0.74) and non-skip breakfast (β=1.13) in adult men, normal weight (β=0.71) and non-skip breakfast (β=1.13) in adult women were significantly related to KDS. The self-control in eating out (β=-0.74) habit had an effect of lowering KDS in older men, non-skip breakfast (β=2.87) habit increased KDS in older women.

Conclusions: We found that various health behaviors were significantly associated KDS index with gender differences. KDS, an index to evaluate the balanced diets or dietary diversity, might be recommended as a predicted indicator to evaluate the effects of health behaviors in the Korean Health action plan to prevent chronic diseases.

Funding sources: This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ01526912022 & Project No. PJ01526922022)" Rural Development Administration, Republic of Korea.]

Keywords: Health Behavior, Korean Diet Score (KDS), Balanced diets, NHANES

Conflicts of interests: none

PAB(T2)-99

Characteristics of physical growth in lean girls at the end of adolescence

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Background and objectives: In Japan, the proportion of lean young women (Body Mass Index [BMI] under 18.5kg/m2) is higher than in other developed countries. The leanness in adolescence might be the reason for leanness in young women. This study aimed to examine the characteristics of physical growth of lean adolescents retrospectively at the end of adolescents.

Methods: This study included 838 girls who entered combined junior high and senior high school in Tokyo from 2005 to 2014; we call them “all subjects”. Data on height, weight, body fat percentage, and bone status were collected from 12 to 17 years old. We also extracted underweight girls (degree of obesity for Japanese children under -15%) at the age of 17 years from all subjects (“underweight group”). Anthropometric data, physical activity and dietary intake from underweight group questionnaire survey were compared to all subjects each school year from 12 years old to 17 years old. We also used a growth chart to assess physical growth.

Results: The annual growth of weight at the age of 16 to 17 years in the underweight group declined by -0.5kg on average, whereas there was an increase of +0.5kg in all subjects. Also, the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

bone status of the underweight group was significantly lower than all subjects. The average energy intake of the underweight group was not significantly lower than all subjects. When we assessed the physical growth using a growth chart, we could clearly see the difference of constitutional leanness and unhealthy leanness.

Conclusions: The characteristics of physical growth from 12 to 17 years old of lean adolescents at the age of 17 years had severe patterns; they are constitutionally lean or remarkably lost weight at the end of adolescence. The latter girls might have a risk of unhealthy leanness, which may cause diseases such as anorexia nervosa.

Keywords: Leanness, Adolescent Girls, Body Fat Percentage
Conflicts of interests: none

PAB(T2)-100

Production and nutritional evaluation of biscuits made from blends of unripe plantain flour, tiger nut flour, ginger, dates and moringa leaves

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Background and objectives: Snacks are a small portion of food generally eaten between meals. They come in a variety of forms such as biscuits and cookies most of which contains "empty and excess calories contributing to overweight and obesity. This study determined the proximate and micronutrient content of biscuits produced from blends of unripe plantain flour, tiger nut flour, ginger, dates and moringa leaves.

Methods: This experimental study involved the production and nutritional analysis of biscuits made from two (2) blends of composite flour [unripe plantain flour (UPF) and tiger nut flour (TNF)] and a constant mix of other ingredients in ratio 20 (moringa leaves:5%, ginger:5% and dates:10%). Samples A, B, C were mixed in the ratio 80:0:20, 40:40:20, 0:80:20. Sample D (UPF:30%, TNF:30%, Ginger:25%, moringa leaves:5%, dates:10%) and E (UPF:30%, TNF:30%, coconut:20%, moringa leaves:5%, ginger:5% and dates:10%). The control sample was a blend of whole wheat:80% and the constant mix of other ingredients in ratio 20. Proximate and micronutrients composition were determined according to AOAC methods. Data was analyzed using SPSS version 25.0 and ANOVA was used to test for mean differences with the level of significance set at 5%.

Results: Sample B had the highest moisture content (22.33%) and sample A the least (11.66%). The ash and fat content were highest in Sample D and C (2.20%, 24.33%) respectively while the least fat content was 16.33% in sample E. The crude fiber and carbohydrate content were highest in Sample B (1.78%, 68.65%) while Sample C had the highest protein content (10.21%). Energy content was highest in Sample A (478K/Cal) and least in sample B (361k/Cal). The control sample (wheat) had the least mineral content (310.31mg, 1.25mg, 242.15mg) while the highest was in Sample D (331.51mg), B (1.30mg) and A (261.20mg) for Ca, Zn and Fe respectively.

Conclusion: The composite blend of ingredients is more nutrient dense than the control sample. This study thus recommends that consumption of biscuits made from the blend of UPF and TNF with other ingredients as a healthy snack for children to prevent non communicable diseases in later adult years.

Keywords: healthy snacks, proximate content, micronutrient, unripe plantain flour, tiger nut flour
Conflicts of interests: none

PAB(T2)-101

Maternal perceived stress, HIV status, and feeding styles are predictors of infant dietary intake in Ghana

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Background: Indicators of poor maternal mental health have been associated with non-responsive feeding styles that affect dietary intake in infants

Objective: To examine the association between maternal mental health indicators and (i) infant dietary intake and (ii) infant feeding behaviors within a 2003 to 2008 longitudinal observational cohort study (the Research to Improve Infant Nutrition and Growth [RIING] project).

Method: A random sample of one third of the RIING cohort (19 HIV positive [HIV-P], 29 HIV negative [HIV-N], and 24 HIV unknown [HIV-U]) and their infants was selected for an in-home 24-hr weighed dietary study at 9 mo postpartum. Maternal depressive symptoms and perceived stress scores had been measured at 6 mo using the Edinburgh Postnatal Depression Scale (EPDS) and Perceived Stress Scale (PSS), respectively. All foods and liquids including human milk were weighed to determine energy and nutrient intake values. Each feeding session was observed, and the feeding style was recorded.

Results: Multiple linear regression showed that maternal perceived stress was negatively associated with total food (-12.4 g, 95% CI: -21.0 to -3.8), energy (-19.5 kcal, 95% CI: -33.8 to -5.2), and fat (-0.7 g, 95% CI: -1.4 to -0.1) intake in infants. An HIV-P status was associated with a lower intake of fat (-6.3 g, 95% CI: -11.1 to -1.5) and vitamin A (-293.9 µg, 95% CI: -529.9 to -57.8) compared to HIV-N. Maternal mental health indicators were not associated with feeding style. However, a positive feeding style was associated with a higher intake of fat (4.8 g, 95% CI: 0.3 to 9.2) and vitamin A (245.3 µg, 95% CI: 28.2 to 462.5) compared to a passive feeding style.

Conclusion: Interventions to improve infant dietary intake should prioritize maternal mental health and promote positive feeding styles among caregivers.

Keyword: maternal mental health, HIV, infant, feeding style, dietary intake
Conflict of Interest Disclosure: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-102
Is iodine deficiency associated with stunted children in South Sulawesi, Indonesia?

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Background and objectives: Stunting and Iodine Deficiency Disorder (IDD) is a serious public nutrition problem, especially in developing countries. Both conditions affect altered linear growth, developmental delays, brain damage, hearing and learning disorders. This study aimed to assess the relationship between stunting and IDD in the areas of goiter endemic.

Methods: A cross-sectional study was conducted in Buntu Batu District, Enrekang Regency. A total of 100 children aged 0-23 months participated in this study. Data were collected through an interview-administrated questionnaire, anthropometric and urinary iodine measurement, and also iodine concentration assessment in household salt. Data were analyzed using the chi-square test.

Results: The prevalence of stunted children was 48%, which the highest proportion was in the 12-17 month age group (72.4%) and among males (55%). A 43% of mothers had median urinary iodine excretion (UIE) <100ug/L, whereas only 3.7% of mothers met the iodine Recommended Dietary Allowance. The coverage of salt iodization that had >30 ppm was only 16%. Bivariate analysis showed a relationship between the lack of iodine content in household salt (p=0.045), maternal UIE (p=0.030), and stunting.

Conclusions: The iodine deficiency was likely to contribute to stunting. Efforts are needed to improve and monitor the iodine salt program, especially in areas with IDD.

Keyword: Iodine Deficiency Disorder, Salt Iodization, Stunting, Urinary Iodine Excretion

Conflict of Interest Disclosure: The authors declare that there is no conflict of interest.

PAB(T2)-103
Increases in Omega-3 Index after krill oil supplementation compared to predicted increases from triglyceride-based omega-3 fatty acid supplements

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Background and objectives: The omega-3 index (O3I) is a recognised biomarker for omega-3 fatty acids (FA) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Achieving an O3I target of >8% has been associated with improved health outcomes. Krill oil (KO) provides EPA+DHA in phospholipid-form as opposed to triglyceride (TG)-form in fish oil, and this may facilitate absorption and result in greater O3I levels.

Objective: To compare increases in O3I with KO supplementation to predicted increases for TG-based omega-3 FA supplements.

Methods: Data were derived from two 6-month double-blind randomized placebo-controlled multicenter trials investigating effects of KO in adults with clinically diagnosed knee osteoarthritis (Study 1: 4g/day KO [0.88g/day EPA+DHA], inclusion criteria <0.5 g/day EPA+DHA intake; Study 2: 2g/day KO [0.44g/day EPA+DHA], no exclusion based on EPA+DHA intake). Superba BOOST KO and mixed vegetable oil placebos were used in both studies. O3I was assessed from finger prick dried blood spots using gas chromatography at baseline, 3- and 6-months follow-up. Predicted changes were calculated using the Walker et al equation including baseline O3I and assuming 0.88g/day or 0.44g/day EPA+DHA TG-based doses. As the prediction equation is based on ~3-month supplementation, baseline to 3-month changes in KO-consuming groups were compared to TG-based predicted changes using linear mixed models including O3I-change (actual vs. predicted) and O3I-change*study interaction.

Results: O3I increased with KO from baseline to 3-months (Study 1: 5.97±1.27% to 8.86±1.52% [n=108]; Study 2: 6.54±1.60% to 7.79±1.51% [n=98]) while remaining constant in placebo groups (n=103 Study 1, n=92 Study 2). O3I-change differed between studies (O3I-change*study interaction, P=0.003). Increases in O3I with KO in Study 1 was greater than TG-based predicted changes (mean[95%CI]: 2.89[2.61, 3.17]% vs. 2.41[2.36, 2.46]%, mean difference 0.48[0.20, 0.76]%, P=0.001) while no differences were seen in Study 2 (1.26[0.96, 1.55]% vs. 1.40[1.35, 1.45]%, mean difference -0.14[-0.43, 0.15], P=0.33). Compliance were >80%.

Conclusion: O3I increased on average 0.5% more after consuming 0.88g/day EPA+DHA from KO vs. predicted change from the same dose triglyceride-based EPA+DHA, while no differences were seen with the lower dose (0.44g/day EPA+DHA). Differences in O3I between KO vs. predicted TG-based omega-3 FA supplements may become more evident at higher dosages.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Walker et al. 2019 AJCN, 110:1034-40.

Keyword: Omega-3 index, Krill oil, Eicosapentaenoic acid, Docosahexaenoic acid, Prediction

Conflict of Interest Disclosure: KA, KG are employees of the study sponsor

Further Collaborators: None

PAB(T2)-104
Protecting the First 1000 Days in Conflict-Affected Myanmar: Lessons Learned from Family MUAC Pilot

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Background and objectives: An estimated 290,000 children under the age of five are expected to suffer from acute malnutrition in Myanmar in 2022 – among them a staggering 49,000 children (17%) suffer from Severe Acute Malnutrition. Exacerbated by the collapse of the health system first during Covid-19 and then crumbling further after the military takeover, coverage of therapeutic and supplementary feeding programs diminished significantly. Resulting in only 1 in every 5 children being reached with Infant and Young Child Feeding in Emergency interventions to mitigate malnutrition. A recent Save the Children (SC) study reported Global Acute Malnutrition rate as 22.3% in Rakhine and 11.9% in Kachin and Norther Shan. To fill a vital need in the absence of a functioning health system, SC piloted Family/Mother MUAC (Mid-Upper Arm Circumference) approach in fragile and conflict-affected Myanmar. Family MUAC is a community screening method which empowers families to screen their own children for acute malnutrition using color-coded MUAC tapes, requiring neither literacy nor numeracy skills.

Methods: Operational research of the Family MUAC approach in four implementation areas to determine feasibility in fragile and conflict affected settings

Results: SC capacitated over 4500 mothers and caregivers of children 6-59 months with the Family MUAC approach. Community volunteers validated the accuracy MUAC measurements by mothers monthly and found 99% of mothers conducted the screening correctly. Surprisingly, during Covid-19 lockdown, families sustained the screenings despite many other activities being suspended. As a result, 46 children suffering from acute malnutrition were detected by families and referred to treatment.

Conclusions: SC learned that Family MUAC is a feasible approach to detect children suffering from malnutrition early as possible in fragile and conflicted-affected areas. Moreover, community capacity strengthening is a viable and vital avenue in remote areas inaccessible by health staff. Given the limited health service access in these complex settings, SC found treatment centers unavailable nor functional in many areas. This poses a profound risk and challenge in ensuring timely, appropriate referral, exacerbated by the deteriorating health system. In response, SC ensured remote support through calls to provide and/or secure appropriate treatment for children.

Keyword: Simplified CMAM, Family MUAC, Fragile and conflict-affected settings

Further Collaborators: Funded by: LIFT Fund

PAB(T2)-105
"Test, Treat and Talk" (T-3) Anemia Camps: An innovative model to strengthen anemia control in India

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Background and objectives Anemia is a serious public health problem in India with more than half of the under-five children, adolescent girls, women of reproductive age, pregnant and lactating women being anemic. India had launched Anemia Mukt Bharat (AMB) strategy in 2018, to address the high burden of anemia with a target for a 3% annual reduction in burden among selected vulnerable groups. Diagnosis and community awareness was one of the key focus areas for the AMB program and was a key challenge for the program. we share an innovative approach to integrating diagnostic, therapeutic, and Social and Behaviour Change Communication (SBCC).

Methods Under the T3 strategy, the participants attending the camps were tested for anemia using digital hemoglobinometers, treated with iron-folic acid (IFA) tablets, and delivered a talk on a diet rich in iron. Medical schools, academic institutions, and partner agencies supported the ministry of Health in conducting the T3 camps.

Results The pilot of T3 camps was conducted in the year 2018- 19 during nutrition (September 2018- 19) and Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA) days in 2019. The prevalence of anemia varied from 39.2% to 48.4% in people screened during these camps. Around 100 such camps were held with a median footfall of roughly 400 participants in each camp. Subsequently, T3 camps were incorporated as one of the activities of the AMB program with human resources, Standard Operating Procedure (SOP), and a budget is provided. Presently, T3 camps are being scaled up across India. The future strategy is to sustain these T3 camps as an integral component of the AMB program. The four-year experience of piloting, scaling up and subsequent consolidation of T3 camp has proven highly beneficial for the AMB program.

Conclusions Test, treat, and Talk (T3) camps have proven to be a valuable innovation for high-level advocacy, demand generation, awareness generation, and Social and Behaviour Change Communication (SBCC). Similar integrated camps may be incorporated into other public health programs.

Keyword: Anemia, camps, demand generation, social mobilization

Conflict of Interest Disclosure: Nil

Further Collaborators: Nil

Keyword: validation, Paediatric 3-MinNS, malnutrition, screening tool

Conflict of Interest Disclosure: All authors declare no conflict of interest.

PAB(T2)-106
Validity and reliability of the malay version of 3-minute nutrition screening-paediatric (paediatric 3-minns)

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Background and objectives: Most of the malnutrition screening tools are developed in the English language, there is limited study in validating their translated versions. The aim of this study is to validate the Malay version of 3-Minute Nutrition Screening-Paediatric (Paediatric 3-MinNS) to determine its reliability and validity for use among hospitalized children.

Methods: The Paediatric 3-MinNS was translated to Malay version. The translation was performed using methods: 1) Forward translation from English version to Malay version by two bilingual translators, 2) Synthesis of forward translation, 3) Back translation from Malay version to English version and synthesis of back translation. The translated items were reviewed by three clinical expects for clarity and comprehensiveness of the tool. The face validity was performed among 14 health care providers to verify the understanding of the items. The reliability was evaluated through inter-rater agreement in 30 participants. The Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP) and anthropometric measurements were used as the reference methods for criterion validity.

Results: The inter-rater reliability (kappa estimation, κ) of Paediatric 3-MinNS between two different staff nurses was 0.814, while the inter-rater reliability (κ) of Paediatric 3-MinNS between a research dietitian and staff nurse was 0.377. The Paediatric 3-MinNS identified 26.1% of 165 participants as being at high malnutrition risk, whereas STAMP identified 27.9%. The sensitivity and specificity of Paediatric 3-MinNS compared with the STAMP were 82.5% and 46.7%, respectively. The sensitivity of the Paediatric 3-MinNS at detecting participants with severe acute malnutrition (weight-for-height z-score of less than -3) was 73.2%, and the specificity was 33.3%. While the sensitivity of the Paediatric 3-MinNS at detecting participants who were severe chronic malnutrition (height-for-age z-score of less than -3) was 75.3% and 33.3%, respectively.

Conclusion: The inter-rater agreement between a research dietitian and staff nurses, and between two different staff nurses were shown to be fair to substantial in this study. The Paediatric 3-MinNS was comparable with other validated nutritional screening tool in diagnostic performance.

PAB(T2)-107
Osteosarcopenic obesity and vitamin D status

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Background and objectives: Low levels of serum vitamin D have been associated with osteosarcopenic obesity (OSO). We assessed the correlations of plasma 25(OH) vitamin D levels with indices of body composition examined by bioelectrical impedance: FM, FM, FFM, TBW and by DXA with an emphasis on lean and bone mass; appendicular lean mass (ALM) as well as on indices such as android/gynoid fat; appendicular lean mass index (ALMI); fat-mass indexes (FMI); fat-free mass indexes (FFMI) and the ALM-to-BMI index.

Methods: 264 adult subjects participated (109 men and 155 women) - aged 20-60 years. Body composition was recorded by bioelectrical impedance (Tanita BC 420 MA, Tanita Inc., Japan) and by Fan-beam dual-energy X-ray (Lunar Prodigy Pro bone densitometer with software version 12.30). The FMI, FFMI, ALMI and ALM-to-BMI index were calculated. Vitamin D was measured by electro-hemi-luminescent detection as 25(OH)D Total (ECLIA, Elecsys 2010 analyzer, Roche Diagnostics).

Results: Serum 25(OH)vitamin D is tightly correlated to FM, % FM and %TBW but not to FFM or TBW. In men the FFM, the FFMI, the TBW and the bone mass were not correlated to vitamin D, while in women they were. In men, visceral obesity ($p < 0.001$) and a lower ALMI were significantly more common ($p < 0.05$). The serum 25(OH)D level was correlated significantly only to the whole body bone mineral content (BMC); ALMI and the ALM-to-BMI index, underlining a predominant role for lean and fat-free mass. People with vitamin D deficiency have significantly lower average levels of the ALM-to-BMI index and fat mass in the hands (Reg. Arms-Lean) compared to those with vitamin D insufficiency.

Conclusions: Serum 25 (OH) D correlates slightly proportionally to moderately with: total bone mineral content and indicators of the risk of sarcopenia - ALMI and the ALM-to-BMI ratio.

Keyword: vitamin D, sarcopenia, obesity

Conflict of Interest Disclosure: No conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-108

Association of dietary fish and n-3 unsaturated fatty acid consumption with diabetic nephropathy from a district hospital in Northern Taiwan

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Background and objectives: Nephropathy caused by diabetes mellitus (DM) is the main cause of end-stage renal disease (ESRD). To understand the association of dietary intake with renal function indicators among patients with diabetic nephropathy (DN), this cross-sectional study was conducted at the dietetic consultation clinic of the Taoyuan Armed Forces General Hospital in Taiwan.

Methods: In total, 317 participants were recruited for this study. Patients with DM who had a urinary albumin–creatinine ratio (UACR) of ≧30 mg/g were defined as having DN. The anthropometric characteristics, blood biochemistry, and renal function of the participants were examined. Furthermore, a semiquantitative 28 food frequency questionnaire (SQFFQ) was administered to investigate the dietary content of the participants and compare the dietary intake of participants with DM.

Results: The result indicated that participants in the DN group were older, were more likely to have a history of diabetes, and had poorer glycemic control and renal function relative to the those in the DM group, Logistic regression models revealed that high fat marine fishes had the lowest odds ratio (OR) compared with other fishes (OR: 0.868; 95% CI: 0.781-0.965, p =0.009). Shellfish, soybean products and skim milk also provided better protective effect to decrease the risk of DN. A further analysis of polyunsaturated fatty acids revealed that total n-3 PUFAs significantly reduced DN risk, while Σn-6 PUFAs did not, especially EPA (OR: 0.821; 95% CI: 0.688-0.979, p = 0.029) and DHA (OR: 0.903; 95% CI: 0.823-0.992, p = 0.033) regardless of whether the variables were adjusted.

Conclusions: Our findings suggest that a diet that incorporates high-fat fish, shellfish, soybean products and a lower Σn-6/Σn-3 ratio can mitigate DN risk.

Keywords: Diabetes mellitus, Diabetic nephropathy, Urinary albumin–creatinine ratio, Estimated glomerular filtration rate, Semiquantitative food frequency questionnaire

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T2)-109

Inadequacy of multiple micronutrients is widespread and spatially varied in Malawi

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Background and objectives: In resource-constrained countries, routine assessment of micronutrient deficiencies (MNDs) is limited to a few "priority" micronutrients including vitamin A, zinc, iron and iodine. We estimated deficiency risks for 17 micronutrients due to inadequate dietary intakes in Malawi, estimated from household consumption and expenditure survey data.

Methods: Household food consumption data from Malawi's 2019/20 Fifth Integrated Household Survey were matched with food composition data from Malawi, Kenya, Lesotho and West Africa, using approaches developed in the Micronutrient Action Policy Support (MAPS) project. Estimated intakes were compared against Harmonised Average Requirement values. Apparent intake of micronutrients was individualized using the Adult Female Equivalent (AFE) approach. Nutrient density of diets was estimated as the ratio of dietary micronutrient:energy supply. Data were transformed and analysed in RStudio (v.4.1.3) to estimate prevalence of inadequate intakes for vitamins A, B1, B2, B3, B6, B9, B12, C and E, and calcium (Ca), magnesium, zinc (Zn), selenium (Se), copper, sodium, potassium and iron (Fe). Micronutrients with ≧50% prevalence of inadequate apparent intake or micronutrient density were further analysed by estimating their median apparent intakes per AFE per day and estimating spatial variation in the prevalence of inadequate apparent intake at district-level.

Results: The prevalence of inadequate apparent intake or micronutrient density exceeded 50% for nine micronutrients: vitamins B2, B3, B12, C, and E, and Ca, Fe, Se and Zn. Among these, only Se showed notable variation in inadequacy when estimated by the apparent intake and nutrient density metrics. The poorest populations had the lowest median apparent intake of the nine shortfall micronutrients. Cereals were the dominant source of vitamins B2 and B3, and Fe, Se and Zn. Vitamin B2 had the highest prevalence of inadequacy, reflecting low apparent consumption of animal source foods. Spatially, districts in central Malawi had a higher prevalence of inadequacy than those in the northern and southern regions.

Conclusions: Inadequate apparent intake of multiple micronutrients, including vitamins B2, B3, B12, C and E, and Ca, Fe, Se and Zn, are prevalent in Malawi. Inclusion of a wider set of micronutrients in routine public health surveillance is warranted.

Keyword: Micronutrients, Inadequacy, Malawi, HCES

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

PAB(T2)-110
Examining and comparing the validity and reproducibility of scales to determine vegetable variety

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Background and objectives: Previous studies have reported that vegetable variety reduces the risk for non-communicable diseases independently of the consumed amount. Because vegetable variety has been assessed by using an existing food frequency questionnaire (FFQ) in numerous studies, it is important to study whether the scales extracted from each FFQ can determine actual vegetable variety. Therefore, this study aimed to examine and compare the validity and reproducibility of several scales.

Methods: Twenty-three nutrition students in Japan were asked about their vegetable intake over the past month using a self-administered questionnaire between July and August 2021. Four patterns of the scales were used: 1) a single question "How many vegetables do you eat per day?" (Single), 2) nine subgroups of vegetables included in a brief-type self-administered dietary history questionnaire (Group), 3) 19 items of vegetables included in a self-administered dietary history questionnaire (Item-1), and 4) 20 items of vegetables from the "Ranking of vegetable consumers in Japan" which was analyzed based on the report on the National Health and Nutrition Survey Japan (Item-2). Vegetable variety was defined as "number of types consumed" for Single, "total score for each vegetable subgroup with one point for consumption at least once a week" for Group, and "total score for each item with one point for consumption at least once every two weeks" for Item-1 and Item-2, respectively. Scale validity was assessed by correlation with the number of vegetable items extracted from semi-weighed dietary records for seven consecutive days, and reproducibility was assessed by test-retest reliability.

Results: Regarding the correlation between vegetable variety based on dietary records for seven consecutive days and the four scales, no significant correlation was found between Single and Group (ρ = 0.28, 0.22), and a significant correlation was confirmed between Item-1 and Item-2 (ρ = 0.51, 0. 44). Reproducibility showed a significant correlation in Group (ρ = 0.45) and a strong correlation in Item-1 and Item-2 (ρ = 0.73, 0.75).

Conclusions: The scales for vegetable items had good validity and reproducibility and may determine actual vegetable variety when compared to the scales for a single question or vegetable subgroups.

Keyword: Vegetable, Variety, Scale, Validity, Reproducibility

PAB(T2)-111
A scoping review of the availability of geospatial information in food composition databases in sub-Saharan Africa

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Background and objectives: Food composition data are valuable to identify and characterise dietary micronutrient status, and inform interventions to alleviate deficiencies. Food composition varies spatially with potentially large effects on dietary micronutrient intake and risks of deficiency, particularly in contexts like in some regions of sub-Saharan Africa (SSA) where dietary diversity is low and food systems are highly localised. However, geographic information is seldom included in food composition tables and databases (FCTs/FCDBs). The objective of this review was to identify published FCTs/FCDBs for use in dietary assessment of calcium, iron, iodine, zinc and selenium in sub-Saharan Africa and to assess the geographic information accompanying current food composition data.

Methods: We conducted a scoping review following the PRISMA guidelines (PRISMA-ScR) and reviewed four databases and other online resources to identify published FCTs/FCDBs in sub-Saharan Africa. Data and metadata were collected to identify the geographic location of the mineral micronutrient values reported for commonly-consumed foods in each FCT/FCDB.

Results: From the 19 FCTs/FCDBs for SSA included for review, >60% of the referenced nutrient values were imputed or borrowed from other FCTs/FCDBs. Twelve FCTs/FCDBs reported the use of analytical values, of which 72% referenced published studies and other publications. Five FCTs/FCDBs reported sampling and analysis of foods as part of the data compilation, whereas only two reported georeferenced information (i.e., coordinates of the sampling location). We attempted to allocate geographic information (e.g., country of origin, sampling location) to each data entry (mineral value per selected food entry) however this was often impossible due to the data structures employed in FCTs/FCDBs, for example where multiple references were provided for a single food item entry.

Conclusions: The majority of datapoints in FCTs/FCDBs for use in sub-Saharan Africa report secondary data with a lack of clear information on geographic origin. There is a need to employ new data structures and improved metadata processes to adequately capture and report geographic information in FCTs/FCDBs, and ensure these are ready to accommodate a new generation of spatially-resolved food composition data.

Keyword: Nutrition, Food composition data, Geographic information, Minerals, Micronutrients

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-112
Nutrition status and Pressure injury among Covid-19 patients in critical care division: case study in pandemic- Phase I

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Background and objectives: The COVID-19 pandemic was the global health crisis and the greatest challenge of our time. It effects to patients and health care worker by changes in care, cost of admitted, mental health status and leading to complication such as pressure injury (PI). The aim of this research was to report the incidence and related factors of PI among Covid-19 patients in Critical care division at Phase I pandemic in a part of Thailand.

Methods: This a retrospective study was analyzed the descriptive statistics such as mean, standard deviation and chi-square test were used to statistically analyze the associated of PI in 18 patients. All subject were confirmed COVID-19 who admitted in Critical care division in Ramathibodi Chakri Naruebodindra Hospital in Samut Prakan province from 1 January - 31 July 2020. All data were include from the Hospital Information System (HIS) that included patient in formation such nutrition status, Braden score, length of stay in ICU, status in ICU, endotracheal intubation, on vasopressor and sedative drug.

Results: The results revealed that the incidence of PI in Covid-19 patients were 5 in 18 patients (27.78%). The factors i.e. the nutritional status (p=0.004), the Braden score (p=0.008), length of ICU stay (p=0.036), endotracheal intubation (p=0.002), on vasopressor (p=0.002) and sedative drug (p=0.002) were associated with PI.

Conclusions: This results suggest that the PI in the critical care unit was important. Therefore, critically ill patients should be treated accordingly to prevent complications.

Keyword: Covid-19, Pressure Injury, Braden score, Nutritional status

Conflict of Interest Disclosure: No Conflict of Interest Disclosure

PAB(T2)-113
Behaviours and Visceral Adiposity among Malaysians' Adults.

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Background and objectives: Chrononutrition, or timing of dietary intake has emerged as novel strategy to improve health outcomes due to its association with weight regulation. A recent tool was developed to assess multiple components of chrononutrition behaviours. The aim of this study was to explore relationship between chrononutrition behaviours and visceral adiposity.

Methods: Community-based cross-sectional survey was conducted to collect data on the adult population in Malaysia. A pre-tested structured questionnaire, Chrononutrition Profile Questionnaire (CPQ), was translated to Malay for assessment of chrononutrition behaviours. Six domains studied were breakfast skipping, largest meal, evening eating, evening latency, night eating and eating window. Responses were scored based on domains in CPQ. Waist circumference (WC) was used as a surrogate marker for visceral adiposity. Spearman correlation was used to test for associations of variables of interest using SPSS version 28. Statistical significance was set at 0.05.

Results: A total of 275 adults participated in this study. Median WC of male and female is 83.8 and 78.7 cm respectively. Median for breakfast skipping was two days per week and the largest meal reported was lunch. Meal latency ranged from 0 to 13.5 hours. Median for night-time snacking was three days per week. Significant negative correlation was found between breakfast skipping and night eating and WC (rs= -0.126, p= 0.040) and (rs= -0.185, p= 0.002) respectively. Evening eating, latency and window as well as largest meal were not correlated with WC.

Conclusions: Our results showed altered chrononutrition behaviours among adults. Chorononutrition behaviours were mainly not correlated or exhibited low correlation with visceral adiposity. Further studies are warranted to investigate protective mechanism of chrononutrition toward fat metabolism.

Keyword: chrononutrition , adiposity , feeding behaviour , dietary pattern , nutritional assessments

Conflict of Interest Disclosure: None.

Further Collaborators: Fundamental Research Grant Scheme (FRGS) from Ministry of Higher Education, Malaysia (FRGS/1/2021/SKK06/UITM/03/3).

PAB(T2)-114
A path to 'FAIR' Food Composition Data

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Background and objectives: Food composition tables/databases (FCTs) are essential to assess population nutrient intake and inadequacy prevalence. Challenges in preparing and using FCTs include the lack of standardization in formats, food names, descriptions, and grouping; also food components (e.g. analytical methods, units, denominators). This impacts data reproducibility, interoperability and re-usability. Our objectives are to (1) apply open science approaches to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

generate human-readable and consistently formatted FCTs, and (2) openly share FCT processing scripts for re-use or adaptation. We thus aim to provide a first attempt to generate a 'FAIR' (findable, accessible, interoperable, reusable) FCT that will exemplify how this approach can be used.

Methods: A single global food composition table was previously developed to ensure consistent assessment of nutrient availability data for the FAO Supply Utilization Accounts. This work further focused on fish and aquatic products collated from thirteen previously selected FCTs. Items were evaluated and allocated standard fish codes and categories (e.g., FAO ISSCAAP, FAO ICS) food components to the FAO/ INFOODS components tagnames (Tagnames). Composition data with varying formats were imported, harmonised?, and combined, before being exported into a standard format. All the steps used scripts and functions created in 'R' software, in RStudio.

Results: Tagnames were provided in six FCTs, for the rest manual identification and renaming was needed which resulted in seventy-seven Tagnames covering available food components and nutrients. Sixteen Tagnames required recalculation (e.g., energy) or a combination of different tagnames, e.g. values for fat content were computed using mixed solvent extraction (FAT), continuous extraction (FATCE) or unknown (FAT-) analytical method values. Similarly, the content of vitamin B6 was obtained either from calculated by summation (VITB6C), analysed (VITB6A) or unknown origin (VITB6-).

Conclusions: Efficient and shared scripts for processing FCTs makes their re-use more readily accessible and traceable, exemplified here by a new fisheries micronutrient FCT drawing on data from thirteen distinct original FCTs. This approach can be extended to other nutrients, geographical regions? or food items to support users worldwide.

Keyword: Food matching, food composition, nutrient intake, nutrient availability, computation

Further Collaborators: Yurika Ueda, Isabela Sattamini, Aydan Selek, Cristina Alvarez, Victoria Padula de Quadros, Adeeba Ishaq, Rachele Brivio, Rita Ferreira de Sousa, Luigi Castaldi, Emiliana Mbelenga, Juan Pablo Parraguez, Sitilitha Masangwi, Pauline Allemand, Nathalie Troubat, Adrienne Egger, Stefania Vannuccini, Carlo Cafiero, Salar Tayyib.

PAB(T2)-115
Nutritional status and dietary intake of ethnic minority students at boarding junior high schools in the region northern mountains in Vietnam

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Background: The nutritional status of students, including those of lower secondary school age, has also become a prominent public health issue that needs to be addressed in the current period. Currently, Vietnam is facing a double burden of nutrition. Besides the high prevalence of malnutrition in children and chronic energy deficiency in adults, the rate of overweight and obesity is increasing, leading to to change the pattern of morbidity and mortality.

Methods: A cross-sectional study was conducted from September 2019 to March 2020 in six mountainous areas of Northern Vietnam among 3172 ethnic minority school-aged children. The nutritional status of students was assessed according to the 2006 WHO Z-score classification for students aged 10 to 19 years. Use the food weight method to collected data on the actual total energy, nutrient composition in the dietary intake.

Results: The rate of undernutrition (BMI/age) of ethnic minority students was 5.3%. The rate of stunting (height/age) among ethnic minority students was quite high at 14.4%. The rate of zinc deficiency in students accounted for 66.7%. The rate of students with anemia accounted for 10.7% and the serum ferritin decreased compared to the prescribed threshold of 15.3%. The overall overweight and obesity rate (BMI/age) of ethnic minority students was 8.5%, of which the rate of overweight was 7.0% and obesity was 1.5%. Student's dietary intake was not balanced and reasonable.

Conclusion: It is necessary to strengthen nutrition interventions that are reasonable and appropriate to the socio-economic conditions of each locality in order to tackle the double burden of malnutrition among ethnic minority children.

Keyword: Malnutrition, Overnutrition, Adolescent, Ethnic and Racial Minorities, Vietnam

PAB(T2)-116
National asessment of anemia and some micronutrient deficiencies among 6-59 month-old children in Vietnam

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Background and objectives: Assessing micronutrient status in children may also have the benefit of addressing the problems of micronutrient deficiencies with a unified programmatic approach on a public health scale. This study was conducted to assess the prevalence of anemia and deficiencies of vitamin A, iron and zinc in 5367 children 6-59 months of age representative for urban, rural and mountainous areas in Vietnam in 2019.

Methods: Hemoglobin concentrations were measured using HemoCue. Plasma ferritin was measured by enzyme linked immunosorbent assay. Plasma retinol concentrations were determined by high-performance liquid chromatography. Zinc was analyzed using a flame atomic absorption spectrophotometer using trace element-free procedures. Definitions of anemia, iron deficiency anemia, iron and zinc deficiencies are classified by the World Health Organization and the International Zinc Nutrition Consultative Group.

Results: Results showed that the prevalence of anemia among children aged 6-59 months was 19.6%, classified as mild

level of public health significant problem. The prevalences of anemia among children living in urban, rural and mountainous areas were, 17.9, 18.1 and 26.1%, respectively. The prevalence of pre-clinical vitamin A deficiency in children aged 6-59 months was 9.5%, classified as mild level of public health significant problem. Prevalence of serum zinc deficiency in children was 58.0% classified as severe level of the public health significant problem. The prevalences of zinc deficiency among children living in urban, rural and mountainous areas were, 49.6, 58.4 and 70.1%, respectively. 26.3% children had iron deficiency. 12.3% children had iron deficiency anemia.

Conclusions: Anemia and micronutrient deficiencies are common in Vietnamese 6-59 month-old children in urban, rural and mountainous areas. Implementing the most effective solutions to fight against micronutrient deficiencies and anemia in order to improve the micronutrient status of the groups at risk of micronutrient deficiencies in community is essential.

Keyword: anemia, micronutrient, deficiency, children, Vietnam

PAB(T2)-117
Underweight and bodyweight prediction equations using neck, calf and mid-upper arm circumferences in Malawian adult patients

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Background: Bodyweight is necessary in all the four steps of nutrition care process; assessment, diagnosing, nutrition intervention, and monitoring and evaluating of nutrition outcomes.

Problem statement: In Malawian public hospitals, unavailability of bed-scales in public hospitals to obtain weight in non-ambulatory patients deter the provision of dietetics services. Hence an urgent need to develop cutoff points and equations from measurements of body parameters that can be used to predict weight status.

Objectives: The study aimed at i) establishing the cut-off point of Mid-upper arm circumference (MUAC) equivalent to body mass index (BMI) <18.5 kg/m^2 in Malawian adult patients; ii) developing bodyweight prediction equations using neck, calf and MUAC in Malawian adult patients.

Methods: Anthropometric data of patients were collected using non-stretchable measuring tapes and Seca scale at Kamuzu Central and Mzuzu Central Hospitals through a cross-sectional study. Pearson correlations were conducted on the following variables weight, height, BMI, sex, age and neck, calf and mid-upper arm circumferences using SPSS version 24. Receiver operating curve in MedCalc version 20 was used to develop MUAC cutoffs for predicting underweight, and multilinear regression analysis was used to develop the equations.

Results: 513 subjects (56.1% females) participated. MUAC <22.4 cm correlated (r = 0.789) with BMI of <18.5 kg/m^2 in both gender, and simplified formulas of weight = (0.9*MUAC [cm] – height [m]) x height (m) x height (m) (for males) and (0.925*MUAC [cm] – height [m]) x height (m) x height (m) (for females) were developed.

Conclusion: In Malawian adult patients, MUAC cutoff point of <24.4 cm predicted underweight status than the current 23 cm for females and 24 cm for males. A height and MUAC based weight estimation equation is proposed for non-ambulatory Malawian adult patients where chair-scales are not available. Therefore, there is a need to validate the derived equation and the MUAC cutoff point for underweight with large population in Malawi.

Keyword: bodyweight, MUAC, Nutrition, anthropometry, Malawi

Conflict of Interest Disclosure: There is no any conflict of interest

Further Collaborators: None

PAB(T2)-118
Comparative study on the proximate analysis and nutritional composition of sweet potato (Ipomoea batatas) bread and wheat bread.

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Background and Objectives: Bread is one of the foods most consumed by individuals in the world. According to a study done by Bakery, Biscuit, and Pasta magazine in 2015, consumption of bread increased by 1.3% to 9.4M tones in Nigeria, rising for the fifth consecutive year after two years of decline. Overall, consumption saw a relatively flat trend pattern. The most prominent rate of growth was recorded in 2012 when the consumption volume increased by 2.4% year-to-year. Over the period under review, consumption attained the peak volume in 2015 and is likely to see gradual growth shortly. Sweet potato (Ipomoea batatas [L.] Lam) is a dicotyledonous plant belonging to the family Convolvulaceae. The plant bears white and purple sympetalous flowers and has large nutritious storage roots. Chronic diseases are the major cause of death and disability worldwide. In Nigeria, chronic diseases are projected to account for 24% of all deaths. At least 80% of premature heart disease, stroke, and type 2 diabetes, and 40% of cancer could be prevented through a healthy diet, regular physical activity. (W.H.O, 2015). Bread provides over half of the caloric intake of the world's population including a high proportion of the intake of carbohydrates, proteins, minerals, and vitamins. The aim of this project is to assess the nutritional composition of sweet potato bread compared to wheat bread.

Method: The sweet potato bread used to make the bread was sourced and bought at Bodija Market, Ibadan, Oyo state. Other ingredients including yeast, flour, sugar, butter, milk were

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

also bought at Bodija Market. The wheat bread was obtained at FoodCo, Bodija, Ibadan, Oyo State.

Result: Results of the proximate composition of the wheat bread, the highest proximate content was carbohydrate (56.13g/100g), followed by crude protein (9.22g/100g) while the least was crude fibre (0.31g/100g) followed by crude fat (1.57g/100g), while proximate composition of the Sweet Potato bread shows, carbohydrate (55.50g/100g), followed by crude protein (11.12g/100g) while the least was crude fibre (0.17g/100g) followed by crude fat (2.05g/100g).

Conclusion: The formation from both wheat and potatoes flour are a good source of nutrients that can be eaten by diabetes patients.

Keyword: Potatoes Flour, Wheat Flour, Diabetes, Non-commendable diseases

PAB(T2)-119
The effects of vitamin micronutrient beverage (VCRESC) on oxidation stress marker and values in healthy subjects

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Background and objectives: 'Healthy Japan 21' outlines the need to consume more than 350g of vegetables per day to reach the recommended daily intake of vitamins. The goal of this research was to examine how a nutritional dietary supplement would affect vitamin values in a healthy subject.

Method: Twenty healthy subjects, (without history of disease) (n=20) consumed hospital vitamin supplement drinks (VCRESC 125ml) for the period of one month. Blood samples were taken before commencement of the study and again after the one month period. Subjects were not given any nutritional guidance and were encouraged to continue their usual daily diets.

Results: Blood vitamin B1, vitamin C significantly increased ($p < 0.01$). However, in both before and after consumption of supplements, blood vitamin C showed a lower value than the standard recommended range. Folic acid, Vitamin B6 and B12 involved in the metabolism of homocusteine (Hcy) showed correlation with Hcy and decreased significantly ($p < 0.01$). Antioxidant capacity test, urinary 8-iso-prostaglandin F2alpha (8-iso-PGF2alpha) and 8-OHdG showed significantly lower values ($p < 0.01$). Urinary 8-iso-PGF2alpha, 8-OHdG in urine showed a correlation ($p < 0.05$), CoQ10 oxidation quotient significantly decreased ($p < 0.01$). . With these results, there is a possibility that a healthy person may have insufficient intake of vitamins and minerals.

Conclusion: Through the long-term intake of a vitamin supplement drink, an overall antioxidant capacity improvement can be observed. However, if the original diet is unbalanced, it is possible that some nutrient scores will not improve.

Vitamin and mineral supplements are valuable to healthy persons, and will require further research on their uses in dietary management.

Keyword: Vitamin supplement, Blood vitamins value, Antioxidant ability, Oxidation stress marker

Conflict of Interest Disclosure: No

Further Collaborators: No

PAB(T2)-120
Evaluation of the effect of Moringa Oleifera in the prevention of low birth weight in Bamako en 2021

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Infant mortality remains high and worrying in developing countries, however the prevention of low birth weight could be one of the strategies that can contribute to the reduction of neonatal mortality. It is in this context that the present study on the use of Moringa Oleifera leaves in the prevention of low birth weight in Bamako was carried out.

An experimental study with three dynamic cohorts concerning 129 malnourished pregnant women under 7 months seen in prenatal consultation in three health centers of Bamako was conducted. They were divided between three supplementation protocols for nutritional recovery (protocol 1 based on enriched flour, protocol 2 based on Moringa powder and protocol 3 based on enriched flour plus Moringa powder). Newborn parameters were collected to compare the effectiveness of the three protocols. The ANOVA test was performed to compare the effect of protocols and logistic regression to identify factors associated with low birth weight with a significance level set at 5%. The study had the approval of the scientific and technical committee and the ethics committee of the National Institute for Public Health Research.

The majority of pregnant women were between 20 and 34 years old (65.89%). For 40.31% of the women in the study, no level of education was observed. Only 2.33% of women had made four prenatal consultations. The same percentage of women were on Vitablé (Group 1) and Moringa (Group 2) i.e. 34.88% and 30.23% were on Vitablé and Moringa (Group 3). The majority of births took place in a health center with 88.37% and 15.5% of newborns weighed less than 2500g. The male sex predominated with 54.26%. Vaginal delivery was 96.12%. It emerged from the multiple regression analysis that the age of the women and the presence of complications were significantly associated with the occurrence of low birth weight with respectively p=0.01 and 0.004. The mean birth weight did not differ significantly according to the protocol received (p=0.65).

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Locally available foods are avenues for sustainable solutions to combat maternal and child malnutrition and improve birth weight.

Keyword: Effect, Moringa Oleifera, pregnant women, low birth weight, Bamako

PAB(T2)-121
A simple and sensitive method for estimation of serum zinc using fluorophore

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Introduction: The essentiality of Zinc (II) in biological functions is associated with the regulation of gene expression, DNA synthesis and apoptosis and nutritional deficiency of this vital element leads to gastrointestinal problems, neurological disorders, growth impairment and immunodeficiency. The problems of zinc insufficiency are well known, still, we lack conventional and widely applicable markers for human zinc status. In the absence of better options, serum zinc is the best marker for zinc status to date. Assessment of cellular zinc pool in humans is mostly done by atomic absorption spectroscopy and by radioactive zinc. The fixed pool of zinc which is non-exchangeable and tightly bound to cellular proteins is difficult to analyze from these methods. Furthermore, the amount of sample used for analysis makes them less likeable indicators. Applications of fluorophores as Zn^{2+} identification tools have emerged as popular biological techniques. Zinquin, a Zn^{2+} specific fluorophore, binds to loose bound labile pool of zinc with a negligible affinity for other cellular trace elements and has been used for tissue studies. Zinquin has the potential to define the relationship between the distribution of labile Zn and the major iZn-binding protein, metallothionein. In this study, we have developed a simple Zinquin-based method for the quantification of serum zinc.

Materials and methods: Standard graph of Zn^{2+} against Zinquin was plotted at Ex/Em=364/490. Interferences of other trace elements such as Ca^{2+}, Fe^{2+}, Mg^{2+} and Cu^{2+} were also tested. Human serum samples (n=20) were treated with 4% Trichloroacetic acid in 1:1 ratio and protein was precipitated. Sample Zn^{2+} (n=80) was estimated and the concentration was quantified. Bland-Altman difference plot was used to compare data obtained from Atomic absorption spectroscopy and Zinquin method for the validation of the method.

Result: Dose-dependent titration of Zinc with Zinquin showed an inflection till it reaches equimolar concentration. (r^2=0.996). Evaluation of different metal ions with Zinquin revealed negligible interference on the binding affinity of Zn^{2+} and Zinquin. Measurements of Zinc in human serum samples were evaluated. Bland-Altman plot validates the degree of agreement of the method.

Conclusion: The developed Zinquin-based method is a simple and sensitive method for the quantification of serum zinc.

Keyword: Zinquin, Atomic Absorption Spectroscopy, Flourometer, Fluorescence

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: NA

PAB(T2)-122
Assessing the association between occupational stress levels and the dietary intake and nutritional status of drivers on the University of Ghana campus

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Background: Work stress has been highlighted as a common occupational concern due to the pressure and increased demand for labour. Studies have shown that employee productivity and performance are heavily influenced by their dietary intake and nutritional state. Higher levels of stress have been linked to poorer eating habits, increased body weight, and thus, inadequate nutrition. This study aimed to determine the influence of occupational stress on the dietary intake and nutritional status of University Ghana drivers.

Methodology: The study was cross-sectional and involved 80 drivers from the University of Ghana, Legon campus. Semi-structured questionnaires were used to assess their occupational stress and the drivers' performance. A 7-day food frequency questionnaire was used to assess their dietary intake. Their anthropometric measurements (height and weight) were also assessed. Data were analyzed using SPSS version 26.0.

Results: 12.5% of the participants were obese, 38.8% were overweight and only 2.5% were underweight. Almost all the drivers (97.5%) had higher dietary diversity scores and only 28.7% of the drivers recorded high occupational stress. There was no association between dietary intake and occupational stress (p = 0.05). However, there was a statistically significant relationship between occupational stress and the nutritional status (BMI) of the drivers (p < = 0.02).

Conclusion: The drivers generally had adequate dietary intake and lower occupational stress. There was a significant relationship between occupational stress and nutritional status. This relationship was however not seen between occupational stress and dietary intake.

Keyword: Occupational Stress, Nutritional Status, Dietary Intake

Conflict of Interest Disclosure: The authors have no conflict of interest to report.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-123
Measuring sodium intake from discretionary salt in New Zealand using the lithium-tagged salt method.

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Background and objective: A high sodium intake is associated with high blood pressure and cardiovascular disease. The amount of sodium from discretionary salt (added in the home or at the table) varies globally, and is unknown in New Zealand. The aim of this study was to estimate the proportion of total sodium intake from discretionary salt in adults using the lithium-tagged salt method.

Methods: Healthy males and females, who regularly consume home-cooked meals, use salt during cooking or at the table, are neither pregnant nor lactating, and aged 18–40 years living in Dunedin, New Zealand, were recruited into the study. Over a nine-day period, participants were asked to collect a baseline 24-hour urine sample (Day 1) to establish their normal lithium output. Discretionary salt was replaced with lithium-tagged salt for seven days. Another two 24–hour urine samples were collected between Day 6 and Day 8. Urinary sodium and lithium were analysed using the Ion–Selective Electrode method and the Inductively Coupled Plasma Mass Spectrometry method, respectively. All statistical analysis were conducted using Stata 17.0.

Results: Of the 116 participants recruited into the study, 109 participants collected complete 24–hour urine samples and were included in the analysis. The median urinary sodium excretion was 3222 mg/24 hours (25th, 75th percentile: 2516, 3969). We found that the median (25th, 75th percentile) estimated sodium intake from discretionary salt was 13% (7, 22) of total sodium intake or 366 mg/24 hours (186, 705).

Conclusions: In a group of healthy adults aged 18-40 years, we found that discretionary salt contributed to 13% of total sodium intake, similar to the United Kingdom and Denmark. Our finding confirms other studies finding that total sodium intake is high (above 2000 mg/day). A range of sodium reduction strategies is recommended. For example, food reformulation to reduce the amount of sodium added to processed foods, front of pack labelling to inform consumers of products high in sodium and public campaigns to promote the purchase of lower sodium products or use less discretionary salt.

Keyword: Sodium, Discretionary salt, New Zealand, Lithium-tagged salt, 24-hour urine

PAB(T2)-124
The serum vitamin D status of medical staffs and the effectiveness of high-dose vitamin D intervention

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Background and objectives: Vitamin D is a fat-soluble vitamin, it involved in skeletal and extra-skeletal health. According to the survey in Taiwan, 25.9% of Taiwanese were vitamin D deficiency (<20 ng/mL). More studies indicated that vitamin D insufficient could increase the risk of upper respiratory tract infection. Medical staffs often work indoor and night shifts, they would easily to become a group of deficiencies if without proper vitamin D intake. The purpose of this study was to investigate the concentration of 25(OH)D and the impact of high-dose vitamin D intervention in medical staffs.

Methods: This study performed from April 2021 to September 2021, included medical staffs from Tungs' Hospital. If participants' 25(OH)D concentration above 20 ng/mL were assigned to normal group, those below 20 ng/mL were assigned to intervention group. Intervention group required daily intake high-dose vitamin D3 supplements (4000IU) for one month, and follow up again after one month without vitamin D3 intervention. All participants were taken blood sample. They were also surveyed using questionnaires with adverse effects of high-dose supplement and frequency of respiratory tract infections at the beginning, and those of intervention group at the end of the supplement and after one month without supplement.

Results: Total numbers of participants were 68, of which 55.9% had vitamin D deficiency. The mean baseline 25(OH)D level for all participants was 20.49±8.93 ng/mL, which was 14.91±3.33 ng/mL in intervention group and 27.57±8.79 ng/mL in normal group. In intervention group, the mean 25(OH)D levels increased significantly to 34.73±8.16 ng/mL (p<0.05), and which reduced to 28.81±6.79 ng/mL after one month without supplement. According to the questionnaire, short-time high-dose vitamin D3 intervention did not cause acute adverse effect. The frequency of respiratory tract infections decreased from 0.34±0.81 to 0.14±0.42 times/person per month, but it was no statistical difference (p = 0.22).

Conclusions: Our study showed that the prevalence of vitamin D deficiency was higher among medical staffs than in Taiwan (55.9% vs. 25.9%). For vitamin D deficient person, short-time high-dose vitamin D3 intervention could significantly increase 25(OH)D levels and not cause acute adverse effect. However, the relationship with respiratory tract infections would need further study.

Keyword: vitamin D, vitamin D deficiency, medical staff, high-dose vitamin D3 supplementation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-125

How accurate are self-reported anthropometrics among Japanese? A scoping review

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1. National Institutes of Biomedical Innovation, Health and Nutrition (Japan)

Background and objectives: Weight and height are frequent measures in nutritional surveillance to assess the population prevalence of obesity. The recent COVID-19 outbreak has increased the need for using self-reported anthropometrics. Its accuracy has often been discussed in the context of assessing overweight/obesity (body mass index, BMI >25.0 kg/m^2). Although previous reviews reported underestimation of obesity prevalence by self-report, little is known about its accuracy in populations where underweight (BMI <18.5 kg/m^2) is also a public issue. Therefore, we aimed to conduct a scoping review on the accuracy of self-reported versus measured anthropometrics in Japan where obesity and underweight problems coexist.

Methods: A literature search was conducted using CiNii Research and PubMed. Studies published in English or Japanese between January 1990 and April 2022 were screened. We included studies conducted in Japan comparing self-reported and measured values of height, weight, and/or BMI. Study design and major outcomes based on observations (e.g., men and women) in each study were extracted and tabulated.

Results: A total of 17 publications (11 in English, 115 total observations) were included in this review, conducted in nationwide cohort settings (n = 4), local communities (n = 4), workplaces (n = 3), and educational institutions (n = 6). The participants' ages (10–91 years) and sample sizes (<100–<30,000) varied across studies. All the studies included the mean differences between self-reported and measured values, showing that the overall tendency for height to be overreported (20/35 observations), weight to be underreported (24/33 observations), and BMI to be underestimated (27/31 observations). Twelve observations included the percentage of misclassification when using BMI based on self-report; 0–40% of overweight/obese and 0–32% of underweight were misclassified to the normal BMI category (18.5–24.9 kg/m^2), while 0–5% and 0–10% of normal BMI was misclassified to the overweight/obesity and underweight, respectively. Four observations showed that weight was more commonly underreported in overweight/obese, but was overreported among underweight people.

Conclusions: Both underweight and overweight/obese individuals are prone to inaccurate reporting, which can underestimate the prevalence of underweight and overweight/obesity. This should be considered in nutritional surveillance using self-reported anthropometrics

Keyword: self-reported, weight, height, body mass index, accuracy

PAB(T2)-126

Intra- and Interindividual variability in postprandial blood Amino Acid kinetics in healthy young adults after ingestion of a good and a moderate digestible protein source

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Background and objectives. Measuring postprandial blood amino acids levels is a relatively easy method used to characterize the quality of a protein source. However considerable individual variation in postprandial amino acid kinetics can be expected due to, amongst others, differences in an individual's digestion and absorption capacity. Therefore, this study aimed to quantify the variation in postprandial AA profiles *between* and *within* individuals after consumption of a good (whey) and moderate (lucerne) digestible protein source.

Methods. In this randomised, cross-over, double-blind trial 18 healthy adults consumed a 20 g protein drink on five occasions. Three times an identical lucerne drink and two times whey, in random order. Blood was collected before and up-to five hours after protein consumption. Blood amino acid kinetics of free amino acids were calculated as Area Under the Curve (AUC), maximum peak height, and time to peak, using an AA response package in R.

Results. On average, lucerne was associated with ~50% lower postprandial AA AUC, a lower peak height and a delayed time to peak compared to whey. However substantial variation *between individuals* was observed, with AUC for whey being 2.1 times higher for the highest versus the lowest subject for total AA (TAA) and 1.7 times for essential AA (TEAA). For lucerne these differences were 3.1 and 2.4 times respectively. Also substantial *within individuals* ('day-to-day') variation was seen, with intra-individual variation being lower than inter-individual variation for whey, but both being of a similar magnitude for lucerne. Finally, there was little-to-no correlation between the response (AUC) on the two proteins sources (r<0.20); in other words those with a high AUC for one protein source were not necessarily those with a high AUC for the other protein source.

Conclusions. Postprandial AA levels after ingestion of 20 gram protein showed substantial variation *between* individuals, as well as *within* individuals. This appeared to be larger for a moderate digestible protein, i.e. lucerne, compared to whey. These results indicate that individual variation in protein uptake kinetics should not be neglected and insights in this variation is warranted to support future optimized protein intake advice to prevent deficiency.

Keyword: amino acids, protein quality, protein digestion, postprandial metabolism, personal nutrition

Conflict of Interest Disclosure: No conflict of interest

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-127
Prognostic Nutritional Index at admission As Predictor of Body Weight Loss and Swallowing Dysfunction at discharge in Older Adults Inpatients

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Background: Older adult inpatients, diagnosing sarcopenia or frailty is determining procedures of mortality or outcomes, partly because body composition assessments measured by radiological modality such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography (US), or dual-energy X-ray absorptiometry (DEXA) that must interfere social distances in COVID-19 circumstances.

Hypotheses: Under such conditions, we hypothesized that: 1) prognostic nutritional index (PNI) is predictor of body weight (BW) change during hospitalization in older adult inpatients (pts) ≧ 65 years old. 2) BW loss is associated with muscle depletion not only in legs but also swallowing muscles.

Aims: To test our hypothesis that pts who showed BW loss at discharge must have impairment of swallowing capacity and poor outcome and that these pts must be predicted by low PNI score and to be target of nutritional interventions at admission, we have conducted this study.

Methods: Participants was sequentially recruited to all inpatients. The exclusion criteria were: shorter stay in hospital. To measure swallowing capacities in recruited pts, Functional Oral Intake Scale (FIOS) and International Dysphagia Diet Standardization Initiative Functional Diet Scale (IDDSI-FDS) for scaling diet textures objectively were applied.

Results: The recruited pts counted 95 cases. Body size and CCI of two groups were similar. PNI score at admission in group with BW loss was significantly smaller than in without group (39.0 vs. 43.6, p=0.040). BW loss group had swallowing dysfunction shown by FIOS and IDDS scores. The cutoff value of PNI among participants to predict BW loss at discharge was 40 determined by ROC curve analysis.

Conclusions: PNI as surrogate biomarker seems to predict BW loss at discharge and swallowing dysfunction in older adult inpatients ≧ 65 years. The cutoff value of PNI was determined 40.

Keyword: Prognostic Nutritional Index, Outcome predictor, FIOS, IDDSI-FDS, Older Adult

PAB(T2)-128
Correlation between energy and vitamin A intakes and their dietary factors among Rwandans

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Background and objectives: Vitamin A is present in different types of food. In industrialized nations, the major sources of vitamin A are animal foods, which are also high in energy. However, as diets in developing countries are plant-based and they rarely eat animal foods, energy and vitamin A intakes may not be positively correlated. In this study, we examined the correlation between energy and vitamin A and the background food consumption patterns observed among Rwandan villagers.

Methods: Energy and vitamin A intakes were calculated using 147 one-day weighed food records (WFRs) collected from 14–70-year-old 36 males and 59 females in rural eastern Rwanda.

Results: No significant correlation between energy and vitamin A intakes was observed for either sex. Matooke green banana was the largest contributor to vitamin A and energy intakes, accounting for about half of all intakes in both sexes. It was consumed in the largest amount among the participants. Because of its high vitamin A content, sweet potato was the second largest contributor to vitamin A, but its contribution to energy intake was only 6.0% for males and 4.9% for females. They barely consumed retinol sources, and milk's contributions to both energy and vitamin A intakes were around 2%.

Conclusions: Although a significant correlation between vitamin A and energy intakes was unobserved, matooke green banana, which is neither an animal food nor a vitamin A-rich food, was consumed much and was the main contributor of both vitamin A and energy intakes among Rwandans.

Keyword: correlation, energy, Rwanda, vitamin A, weighed food record

PAB(T2)-129

Select nutritional problems among adolescent girls in an urban resettlement colony, New Delhi- a mixed method cross-sectional study

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Background and objectives: In India, 39.7% of adolescent girls are thin by WHO-BMI criterion and 59.1% girls are anaemic while about 5.4% girls are overweight according to NFHS-5. CNNS-2021 however shows 18.9% adolescent girls to be thin and 4.7% to be overweight / obese by WHO BMI-for-age. Several studies have been done regarding nutritional status of adolescent girls over the years which have reported wide range of prevalence of malnutrition. We assessed the prevalence of malnutrition and anemia amongst adolescent girls, and association of malnutrition with various socio-demographic factors and other variables.

Methods: 426 adolescent girls were selected using simple random sampling from the MIS of CCM, AIIMS, New Delhi. Semi-structured questionnaire was administered among 386 of them. Height, weight, MUAC, haemoglobin (by HemocueHb301) were measured. 24 hour dietary recall was done among 386 girls and food frequency questionnaire was also administered among 94 participants. For qualitative study four FGDs were conducted among Anganwadi workers, mothers and adolescent girls.

Results: By WHO BMI-for-age criteria, 18.9% (95%CI 15.1-23.2) were underweight and 10.6 % (95%CI 7.7-14.1) overweight and 3.9% (95%CI 2.2-6.3) were obese among 386 girls. With WHO-BMI as an indicator, the prevalence of thinness was 51.8% (95%CI 46.9 – 56.9), overweight was 10.6% (95%CI 5.7 – 11.5) and obesity was 1.0% (95%CI 0.2 – 2.6). Prevalence of anemia was 64.2% (95% CI 59.2-69.0); 29.8% (95% CI 25.3-34.6) mild, 32.6% (95% CI 28.0-37.6) moderate and 1.8% (95% CI 1.0-3.7) severe. BMI-for-age strongly correlated with MUAC-for-age (r=0.7). MUAC-for-age was significantly associated with calorie consumption (p = 0.004). 73% and 68% girls respectively consumed aerated drinks and chips weekly. On multivariable logistic regression, having low birth weight (OR 2.2, 95%CI 1.2-4.2, p value 0.02) and calorie deficiency (OR 6.0, 95%CI 1.7-21.8) were significantly associated with under-nutrition by BMI-for-age z scores. Anemics had 70% lower odds of having over-nutrition (OR 0.3, 95%CI 0.2-0.6, p value 0.001). Qualitative analysis revealed that the main reason behind malnutrition is perception about own body image and preference for fast foods.

Conclusion: Malnutrition and anaemia continued to be the major public health challenges amongst adolescent girls in urban resettlement population.

Keyword: Adolescent girls, Thinness, Overweight, Malnutrition, Anemia

Conflict of Interest Disclosure: There is no conflict of interest in this study.

Further Collaborators: None

PAB(T2)-130

Serum undercarboxylated osteocalcin levels in stunted and non-stunted Filipino children and the association with growth

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Background and objectives: Vitamin K is a cofactor to γ-glutamyl carboxylase, an enzyme that carboxylates (activates) osteocalcin. Carboxylated osteocalcin binds to calcium and transports it into the bone, thus facilitating mineralization. High circulating levels of undercarboxylated osteocalcin (ucOC) may indicate vitamin K inadequacy. There is currently a lack of data on the serum content of ucOC in Asian children. This study determined the serum ucOC levels among children in the Philippines, and its association with linear growth.

Methods: Data and serum samples of stunted (n= 174) and non-stunted (n=176) children aged 1 to <5 years from the 2019 Expanded National Nutrition Survey were utilized. Weight and height were measured using standard techniques. Dietary intake was collected using a 2-day non-consecutive 24-hour food recall. Usual energy and nutrient intakes were estimated using PC-Software for Intake Distribution Estimation (PC-SIDE) Program. Socio-economic and demographic data were collected via interview-administered questionnaires. Serum ucOC content was measured using enzyme-linked immunosorbent assay (ELISA) kits. Multiple linear regression analyses were conducted to determine the association of serum level of ucOC with linear growth, as indicated by height-for-age z-scores (HAZ).

Results: The overall median serum concentration of ucOC was 18.9 ng/ml. Median serum ucOC was higher in stunted children compared to non-stunted children (26.9 ng/ml vs. 16.4 ng/ml, p = 0.0379). Intakes of protein, phosphorus, and calcium that promote bone development were significantly higher ($p<0.05$) among non-stunted than stunted children. In the energy-adjusted multiple linear regression model, serum levels of ucOC were found to be significantly associated with HAZ. An increase of 0.37 HAZ (p=0.04) was observed at the lowest tertile of serum ucOC (1.1 – 13.8 ng/ml). Dietary iron intake, hemoglobin values, wealth index, and mother's work status were also significantly associated with HAZ.

Conclusion: The higher serum ucOC concentration seen among stunted kids suggests that these children may not consume sufficient vitamin K to support optimal bone development. As vitamin K is known to be a key nutrient for bone health, ensuring an adequate intake of this vitamin along with other bone-building nutrients should not be overlooked, especially during childhood.

Keyword: stunting, linear growth, children, Philippines

Conflict of Interest Disclosure: The authors of this study declare no conflict of interest in the conduct of this study or in the generation of its results.

PAB(T2)-131

Sources of dietary vitamin D and determinants for vitamin D status during pregnancy in the Norwegian Mother, Father and Child Cohort Study

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Background and objectives: The determinants of plasma 25-hydroxyvitamin D [25OHD] differ between countries due to differences in latitude, cultural habits, and fortification and supplement policies. There is a need to better understand the contribution of dietary vitamin D intake as determinant of 25OHD in pregnant women in Norway. The aims of this study were to (1) describe the sources of dietary vitamin D, and (2) investigate determinants of 25OHD, in pregnant women in Norway.

Methods: This study is based on data of 2960 women participating in The Norwegian Environmental Biobank, a sub-study within the Norwegian Mother, Father and Child Cohort Study. Total vitamin D intake (foods and supplements) was estimated from a food frequency questionnaire in gestational week 22. Plasma 25OHD in gestational week 18 was analyzed by chemiluminescent microparticle immunoassay. Other covariates were collected by questionnaires in gestational weeks 15 and 30. Multivariable linear regression analysis investigated the determinants of 25OHD, and restricted cubic splines predicted response in 25OHD by total vitamin D intake in a linear regression.

Results: Median (interquartile range) vitamin D intake was 3.1 (2.1-4.3) µg/day from foods, and 5.2 (2.6-10.0) µg/day from supplements. Major sources of vitamin D were supplements (66%), fish (14%), and fortified margarine (10%). Intake of supplements and margarine, but not fish, differed between women with different 25OHD concentrations. Significant determinants of 25OHD were higher total vitamin D intake, lower energy intake, summer season, high income country of origin, higher education, lower pre-pregnancy BMI, higher age, lower c-reactive protein, solarium use and non-smoking during pregnancy. Together, these variables explained 24% of the variation in 25OHD. From October to May, a total vitamin D intake >8-10 µg/day seemed sufficient for most to reach 25OHD >50 nmol/L. From June to September, 25OHD was sufficient regardless of vitamin D intake.

Conclusions: Vitamin D supplements and fortified margarine are important contributors to total vitamin D intake and to maintain sufficient concentrations of plasma 25OHD, especially during the winter, in pregnant women in Norway. The available determinants explained 24% of the variation in 25OHD.

Keyword: Vitamin D, Supplements, Diet, Pregnancy, The Norwegian Mother, Father and Child Cohort Study

PAB(T2)-132

Nutrient intake and nutritional inadequacy of Khasi tribal children (1 to 9 years old) of West Khasi Hills, Meghalaya, Northeast India.

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Background and objective: Around 104 million indigenous tribal people reside in India. Their food intake is usually influenced by their peculiar habitat, with large seasonal variations depending on availability and accessibility. As the indigenous people of Northeast India have not been thoroughly investigated on their ecosystem in relation to nutritional status, we investigated the prevalence of nutritional status and nutrient inadequacy of the Khasi tribe of Meghalaya who are the fifteenth largest tribe in India.

Methods: Sample size was calculated by a random sampling procedure using 42% prevalence of stunting, with 5% precision and 95% confidence interval. Out of 1109 households included for the study, 499 children were estimated to cover for this study. Household food and nutrient intake conducted in the subsamples of 25% households where, 24-hour recall method used to record food intake and the nutrients. Dietary adequacy and Estimated Energy Requirements (EER) using appropriate methods. Probability of adequacy (PA) of 11 micronutrients were calculated using estimated average requirements (EARs).

Results: Median intake of macronutrients protein, fat, carbohydrates and fiber significantly increased across the age group. Protein intake in 1–3 years age group found significantly higher in girls (32.52 g/day) than boys (28.98 g/day). No significant difference observed on the median intake of fat, fiber, vitamins between boys and girls. The median intakes of vitamins such as among boys and girls of 1–3, 4–6 and 7–9 years was not significantly different. However, significant median intake difference of iron and zinc observed between boys and girls. The daily median energy intakes among the age groups of 1–3, 4–6 and 7–9 was 1291, 1481, and 1762 kcal/day respectively. The lowest PA was observed for micronutrients in both the genders and no significant difference of MPA between the gender.

Conclusions: This study is vastly explorative and has generated many components that need future and interventional research related to food and nutrition. Nutritional status in terms of probability adequacy have studied in Khasi tribes of Meghalaya and found low. Similar studies also can be conducted other tribal population of India to understand their nutritional status.

Keyword: Indigenous foods, Nutritional status, Nutrient intake, Probability of Adequacy, Tribal health

Conflict of Interest Disclosure: We have no conflict of interest among the co-authors. Therefore, no information available to be disclosed.

Further Collaborators: Not applicable

PAB(T2)-133
Barriers influencing effective and efficient vitamin A supplementation (VAS) during the Maternal and Child Health Nutrition Action Week (SASNIM) in Cameroon

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Background and objective: During the bi-annual Maternal and Child Health Nutrition Action Weeks (SASNIM) in 2021, coverage of Vitamin A Supplementation (VAS) among children aged 6-59 months, fell below the national target of 80%. In this study, we used a bottleneck analysis approach to identify the barriers to effective and efficient delivery of VAS through SASNIM.

Methodology: This study was conducted in the Centre, Littoral, East, Adamawa, North and Far-North regions of Cameroon, using a descriptive mixed-methods design. Sources of information were grey literature (~80 planning, financial and implementation-related documents), semi-structured interviews (125) with key stakeholders from the central, regional, district, health and community levels, and focus group discussions (18) with community distributors, and caregivers of children aged 6-59 months. A quantitative survey was conducted among 3616 caregivers of children aged 6-59 months.

Results: Only 67.7% of target children aged 6-59 months received VAS in the first semester SASNIM in May 2022. The main bottlenecks identified in the SASNIM were inefficiencies in coordination and micro-planning. The dependence on partner funding impacts the governments' ability to plan and coordinate the SASNIM, as funding is generally received late which causes inefficiencies in program management and delays the operationalization of critical activities such as leveraging appropriate communications resources and having sufficient community sensitization prior to the SASNIM. Inefficiencies in micro-planning including inaccuracies in target population estimation, late arrival of supplies and vitamin A capsules, and delayed training and availability of data collection tools, which can result in overlooked critical populations, misallocation of staff and supplies, and poor data management and improperly calculated coverage estimates.

Conclusion: Key stakeholders in Cameroon will explore the bottlenecks further and identify possible remedial approaches for coordination, micro-planning, procurement of supplies, data collection training and tool preparation, and take the necessary steps to test proposed interventions to overcome the bottlenecks identified.

Keyword: VAS

PAB(T2)-134
Reportsof Dietary Supplement Product Use and Nutrient Intakes Among Dietary Supplement Users Varies by Dietary Assessment Method

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Background and Objectives: Reliable dietary assessment instruments for assessing total nutrient intake (i.e., foods/beverages + dietary supplements (DS)) are critical for nutrition monitoring; yet different tools vary in their robustness for assessing dietary intake, and much is unknown about how these tools perform when measuring DS intake. The Interactive Diet and Activity Tracking in AARP (IDATA) cohort study was designed to evaluate the validity of 24-hr dietary recall (24HR) and Diet History Questionnaire (DHQ) II data, inclusive of DS. This study aimed to compare DS data reported on ≧2 24HRs and the DHQII from the IDATA study among U.S. adults (50-74y; n=795).

Methods: DS information was collected over 12 months among IDATA participants who completed ≦6 Automated Self-Administered 24HRs (ASA24s) and 2 DHQIIs which queried information on DS usage, frequency, and amounts taken. Prevalence of DS use, mean calcium and vitamin D intakes, and intakes per consumption day from DS (by source and sex) among DS users were compared between the 2nd DHQ II and the average of ≧2 ASA24s using paired t-tests; significance was set at $p<0.0083$.

Results: Most U.S. adult DS users who participated in IDATA reported DS use on the DHQ (84%) and on ≧2 ASA24s (84%). Among the DS products reported on ≧2 ASA24s and the DHQII, agreement between the methods ranged from slight ($\kappa=0.06$; multivitamin) to substantial ($\kappa=0.70$; calcium and vitamin D). Mean calcium intake primarily originated from the diet and calcium and vitamin D DS, but intakes were not significantly different between methods for either sex. For vitamin D, a large proportion of intake originated from DS (i.e., single vitamin D) and intake varied significantly between the DHQ (8.9-9.5 mcg/d) and ≧2 ASA24s (18.7-24.9 mcg/d), regardless of sex ($p<0.0001$). Mean consumption day intakes for vitamin D were significantly higher on ≧2 ASA24s (24-45 mcg/d) than on the DHQII (11.6-14.1 mcg/d) for both sexes ($p<0.0001$).

Conclusions: Currently, the best method for measuring intake from DS is unclear. The comparability of 24HRs and FFQs in estimating the prevalence of use of and nutrient intakes from DS varies by nutrient, source, and DS product types consumed.

Keyword: Methodology, iDATA, Dietary Supplement, Dietary Assessment

Conflict of Interest Disclosure: AEC and JAT have no conflicts of interest to disclose. Unrelated to this study, RLB has served as a consultant in the past to the NIH Office of Dietary Supplements, Nestlé, the General Mills Bell Institute, RTI International, and Nutrition Impact; and is a trustee of the International Food Information Council and a former board member of International Life Sciences Institute-North America. RLB has received travel support to present her research on dietary supplements from

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Council of Responsible Nutrition, American Society of Nutrition, and the New York Academy of Sciences.

Further Collaborators: The authors would like to thank Jaime Gahche, PhD for her statistical consultation and scientific contributions on this project.

PAB(T2)-135

Thiamine diphosphate predicts erythrocyte transketolase activation coefficient among young hospitalized children with suspected thiamine deficiency, their mothers and a community-based comparison group in northern Lao PDR

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Background and objectives: The correlation among different biomarkers of thiamine status and their relationship with clinical signs of thiamine deficiency disorders (TDD) remain uncertain. The present analyses explore correlations between two biochemical indicators of thiamine status among young children and their mothers in Lao PDR.

Methods: Hospitalized children (ages 21 days – <18 months) were eligible, if they presented with symptoms suggestive of TDD. Children were enrolled in a community-based comparison group, frequency-matched by age, sex and residence. Mothers of enrolled children were eligible for participation. From children and women, venous whole blood thiamine diphosphate (ThDP) was determined by HPLC, and erythrocyte transketolase activation coefficient (ETKac) was assessed by UV spectrophotometer in washed erythrocytes. Associations between biomarkers were assessed using Spearman correlations, and a ThDP cutoff corresponding to ETKac >1.25 was explored using area under the receiver operating characteristic curve (AUROC), with optimal cut-offs selected via the closest-to-(0,1) corner cut-point approach.

Results: Thiamine biomarkers were available for 626 children (mean±SD age 4.5±3.4 months; 58.9% male) and 655 women (24.7±6.4 years). Median (IQR) ThDP and ETKac were 79.8 (48.2, 144.0) nmol/L and 1.21 (1.06, 1.42), respectively, among the 395 hospital children, and 64.7 (50.0, 87.8) nmol/L and 1.22 (1.12, 1.37) among community children. ThDP and ETKac were 71.0 (55.5, 88.1) nmol/L and 1.29 (1.17, 1.43) among mothers of hospitalized children, and 73.6 (54.6, 94.6) nmol/L and 1.23 (1.15, 1.30) among community mothers. ThDP and ETKac were well correlated in hospital (r=-0.84) and community children (r=-0.64), and less strongly in their mothers in the hospital (r=-0.51) and community (r=-0.19) cohorts. Among all children, ThDP was strongly predictive of an ETKac cutoff of >1.25 with an AUROC of 0.88; a ThDP cutoff of 67 nmol/L had a sensitivity of 0.80 and specificity of 0.81. Among all women, ThDP predicted the ETKac cutoff of >1.25 with an AUROC of 0.67 with a proposed ThDP cutoff of 74 nmol/L (sensitivity 0.67; specificity 0.62).

Conclusions: Whole blood ThDP was predictive of ETKac in young children and their mothers. Assessment of ThDP by HPLC is simpler than measuring ETKac, so may be more useful for population assessment.

Keyword: Thiamine, Thiamine diphosphate, Erythrocyte transketolase activation coefficient, Lao PDR

Conflict of Interest Disclosure: KHB, the spouse of SYH, previously worked for the Bill & Melinda Gates Foundation. All other authors declare no conflicts of interest.

PAB(T2)-136

Application of a Questionnaire Analysis to Identify the Correlation between Dietary Habits and Covid-19 Diagnoses

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Background and objectives: In the past few years, Covid-19 has spread globally. Meanwhile, it is understood that dietary habits play an important role in human immunity. Therefore, it is hoped that by conducting a questionnaire analysis on dietary habits, a correlation between nutrients and Covid-19 diagnoses can be identified.

Methods: From June to August, 2022, the nutrition clinic recruited 30 participants who were Covid-19 positive and 30 who were negative. The participants were asked to fill in an online dietary questionnaire to analyze their dietary habits over the previous month. The results of the systematic analysis include the proportion of three main nutrients (carbohydrates, lipids, and proteins), the minerals calcium, phosphorus, iron, magnesium, and zinc, and vitamins A, D, E, B-complex, and C. The survey results were compared using the Student's *t* test and Pearson Correlation analysis.

Results: During the study period, data were collected from a total of 60 people, including 31 females and 29 males, with an average age of 54.7±17.6. The results show that the dietary intake of vitamin B2, B6 and the protein/body weight ratios of the Covid-19 positive participants was significantly lower than that of the negative participants (*P*><0.05). In the correlation analysis, protein/body weight ratios had a significant positive correlation with phosphorus, iron, zinc, vitamin D, E and B complex vitamins. Vitamin B2 and B6 had a significant positive correlation with magnesium, zinc, vitamin D, E, and C.

Conclusions: Adequate intake of protein and foods rich in B-complex is very important. They can effectively improve the human immune system and are expected to reduce the diagnosis rate of Covid-19.

Keyword: Covid-19, Protein, Vitamin B-complex

PAB(T2)-137

Correlation of nutritional status with *Clostridium difficile* infection in inpatients: A four-year (2017-2021) retrospective study

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Background and objectives: *Clostridium difficile* infection (CDI) is increasingly common in health-care facilities, and represents 10-25% of antibiotic-associated diarrhea (AAD). Few studies performed that CDI is significant cause of nosocomial diarrhea in Taiwan. The awareness of CDI is increasing recently, but due to the lack of prognosis and risk factors may lead to misdiagnosis. Moreover, limited studies discussed about the association between nutrition status and CDI incidence. Therefore, an retrospective study was conducted to analyze the association of CDI incidence and the possible related risk factors.

Methods: Adult patients (age > 18 yr.) that has detected *C. difficile* toxin in fecal samples in between January 1, 2017 to December 31, 2020 was recruited for this study. The following data were collected through the Taipei Medical University Hospital database, including demographic data (age, gender, height, weight and length of hospital stay), historic data (comorbidities, nutrition status, intensive care units admit, nutrition route and nutritional intake) and laboratory data. The association between CDI and ICU admission and comorbidities was analyzed using spearman correlation, nutrition intake between patients with or without ICU admission was analyzed using unpaired *t*-test.

Results: Among 2616 stool samples were detected, a total 188 cases were identified as CDI. The total incidence rate was 7.1%. The mean age was 69.1± 17.2 yr. 24.5% cases were admitted to ICU prior development of CDI. The mean score of nutrition risk screen score 2002 (NRS 2002) were 3.2 ± 1.7. The length of hospital days was 33 ± 32.5 days. The length of hospital stays was found modestly correlated with age (r=0.14, p <0.05), ICU admit prior development of CDI (r=0.25, p <0.01) and having pulmonary disease (r=0.16, p<0.05). There was no found of correlation between nutrition status and the length of hospital stay. Patients without ICU admission history showed significantly higher calorie and protein intake percentages than those with ICU admission.

Conclusions: Incidence rate of CDI was found positively correlated to admission of ICU, the length of hospital stay, and aged. CDI patients was found to have moderate nutrition risk, though the correlation with the length of hospital stay was not found, but actual calorie and protein intake was affected by ICU admission.

Keyword: Clostridium difficile infection, Antibiotic-associated diarrhea, Nutritional status

PAB(T2)-138

Development of a comprehensive food composition database for Australian-grown horticultural commodities

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Background and objectives: The Australian agricultural industry supplies a wide range of horticultural commodities to domestic and international markets. Food composition data can be used to highlight the nutritional content of plant foods; however, many of the relevant data reported in the Australian Food Composition Database (AFCD) were generated up to 30 or more years ago, and may not be representative of produce currently available. Hence, we aimed to develop a comprehensive, nationally representative, food composition database for Australian-grown fruit, vegetable, and nut commodities.

Methods: Data gaps in existing AFCD data (missing/outdated data) were determined for 92 commodities identified as priority commodities by industry stakeholders. Samples were purchased at the peak of their growing season across Sydney, Melbourne and Perth between June 2021 and May 2022, and prepared as they would be consumed (e.g., trimmed, peeled, de-seeded). All nutrients were measured at the National Measurement Institute of Australia (NMI), with the exception of dietary fibre, starch, vitamin B7 and folate, which were measured by specialist laboratories in Australia. Raw samples were analysed, with the exception of chestnuts, which were baked, and mushrooms and eggplant for which cooked and raw samples were analysed. For other foods that may be consumed cooked, nutrient concentrations were estimated using weight change and nutrient retention factors. Vitamin C was measured in individual samples in most cases; for other nutrient components, a composite sample of each commodity was analysed.

Results: A total of 932 primary samples were purchased (6-19 samples per commodity) and analysed as 349 individual samples for vitamin C and as 102 composite samples for other components. The database covers up to 148 nutrient components in 151 raw and cooked food entries (fruit/vegetables n=147; nuts n=4).

Conclusions: This study has provided new composition data for Australian horticultural commodities that are representative of current growing practices, climatic conditions, preferred varieties, and analytical methods. The data will be incorporated into future releases of the freely available AFCD. The data will allow industry stakeholders to identify and promote commodities for their nutrient content, and will provide a valuable resource for health professionals, research and the general public.

Keyword: Australia, food composition, fruit, nuts, vegetables

Conflict of Interest Disclosure: This project was funded by Hort Innovation.

PAB(T2)-139

Increasing the knowledge base on aquatic foods: Expanding and updating the FAO/INFOODS Global Food Composition Database for Fish and Shellfish

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Background and objectives: quatic foods — animals, plants and algae harvested from freshwater and marine environments — supply protein to over 3.2 billion people, are a key source of essential micronutrients for many urban, rural and indigenous communities. Despite their contribution to food systems globally, aquatic foods are underrepresented in discussions about how to feed the world's population sustainably. Accurate food composition data for aquatic foods are needed, not only to estimate their contribution to the nutrient intakes of individuals and populations, but also for the development of food-based dietary guidelines and for labelling purposes. The FAO/INFOODS (International Network of Food Data Systems) Global Food Composition Database for Fish and Shellfish (uFiSh), published in 2016, is openly available in Excel and helps address this data gap. Considering that since its publication new analytical data is available in the literature, an update and expansion of the uFish is necessary.

Methods: As part of a wider collaborative effort to increase the knowledge base on aquatic foods, a comprehensive literature search is being performed to compile analytical data published since 2016. The compilation and documentation will follow FAO/INFOODS standards and guidelines. In addition, the database, which is currently limited in coverage to mainly fillet and raw fish, crustaceans and molluscs, will be extended to include other fish and aquatic products, for example, sea urchin, roe, sea plants such as water spinach, algae, seaweed, and aquatic animals such as sea snails, and sea cucumbers. Other complementary databases, such as FishBase and FishNutrients, will be updated as part of this collaboration.

Results: Results from the identification, evaluation and validation of new sources of data will be presented.

Conclusions: The update and expansion of uFish will increase the quality and quantity of accurate and available food composition data on aquatic foods globally. Such data can also enable countries and researchers to incorporate more of these data in national and regional FCT/FCDBs, allow better calculation of nutrient intakes from aquatic foods, and integration of aquatic foods into programmes and policies. This collaborative initiative paves the way for novel approaches to improve data availability globally.

Keyword: Food composition, Food matching, Nutrient intake, Aquatic foods , Fish

Conflict of Interest Disclosure: None

PAB(T2)-140

Nutritional status and cardiometabolic health among adolescents: findings from Harare, Zimbabwe.

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Background and Objectives: Overweight and obesity among adolescents is a global public health concern, especially in lower- and middle- income countries where it co-exists with undernutrition due to rapidly changing dietary habits, poor nutrition knowledge and reduced physical activity. Overweight/obesity is complicated by cardiometabolic indices (CMI) characterized by high total cholesterol (TC), fasting glucose (FG), waist/hip ratio (WHR), and blood pressure (BP). In Zimbabwe, screening for cardiometabolic risk (CMR) is not prioritized especially among adolescents. This study assessed the prevalence of obesity, cardiometabolic risk factors, and participants characteristics associated with CMI.

Method: The study was done among high school adolescents in Harare, Zimbabwe. Three hundred and twenty students aged 14-19 years consented to participate in the study. Questionnaires on sociodemographic characteristics, dietary habits, and physical activity were self-administered. Blood pressure (BP), height, weight, and waist circumference were measured, and finger prick blood sampling was done for FG and TC. Waist circumference and height was used calculate WHR. Body mass indices were determined as the weight per square of their heights. The results were analysed on IBM SPSS version 26 at $p \leqq 0.05$ significance level. Binary logistics regression analysis was done to identify predictors for CMR and CMI.

Results: The prevalence of obesity was (17.5%), (75%) among girls and (21.4%) among boys and (3.6%) preferred not to say. The prevalence of CMR was 225(70.3%), girls (60.4%) and boys (38.6%). CMI were clustered with high proportions among 14-16year olds and girls. WHR was higher among boys (55.0%) and TC was higher among girls (71.3%). Family size (i.e., numbers of siblings) was a significant predictor for CMR (OR=0.511). Gender (0R=1.815) and inadequate knowledge for malnutrition related diseases (OR=1.812) predicted high TC. Gender (OR=0.598) predicted high BP. Gender (OR=0.452) and skipping meals (OR=3.179) predicted high WHR, and place of residents (i.e., uptown or downtown) predicted high FG (OR=3.937).

Conclusion: Results suggest the co-existence of obesity and CMR among Zimbabwean adolescents. There is an urgent need to develop gender sensitive, family and culture-oriented nutrition intervention programmes in strategic locations, to improve and control obesity, CMR and CMI.

Keyword: Zimbabwe, Adolescents, Cardiometabolic risk, Cardiometabolic indices, Overweight/obesity

PAB(T2)-141

Pregnancy Physical Activity Questionnaire (PPAQ) is a Sensitive Tool for Predicting Percentage Body Fat in Pregnant Women: Findings from Indonesia

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Background and objectives: High percentage body fat (%F) is associated with preeclampsia which is risk factor for preterm deliveries and perinatal mortalities. Studies have shown that sedentary activity is associated with higher %F. Therefore, it is important to estimate accurately the physical activity of pregnant mothers using the appropriate tool. In this study, two different tools were used to assess the level of physical activity and its association with the %F of pregnant Indonesian women in the second and third trimesters.

Method: This cross-sectional study is part of a larger observational cohort study in East Lombok Regency, West Nusa Tenggara Province, Indonesia, entitled "UKRI GCRF Action Against Stunting Hub (AASH)". Andhra Pradesh Child and Parent's Study - Physical Activity Questionnaire (APCAPS-PAQ) and Pregnancy Physical Activity Questionnaire (PPAQ) were used to estimate the physical activity (MET-h/week) of 702 pregnant women during T2 and T3 respectively. Percentage body fat was assessed using Siri's equation with body Density estimated by Durnin and Womersley equation using triceps, biceps, and sub-scapular skinfolds. Student's T-test was used to examine the mean difference of %F between women with sufficient vs insufficient physical activity (≧50 vs <50 MET-h/week total activity, respectively) as well as between the women who achieved the physical activity level (≧7.5 vs <7.5 MET-h/week) recommended by Centers for Disease Control and Prevention's (CDC).

Results: Majority (73.5%) of pregnant women were housewives. Women in the third trimester of pregnancy were more inactive (44.6 MET-h/week) than in the second trimester (66.5 MET-h/week). The highest amount of energy (26.7 and 26.8 MET-h/week) was spent on household activities in both trimesters. There was a significant difference in %F of women based on sufficiency of physical activity level measured by PPAQ (52.9% vs 53.8%, p <0.012). On the other hand, there was no difference in %F based on sufficient physical activity level measured by APCAPS-PAQ (52.5% vs 52.6%, p= 0.805).

Conclusions: PPAQ demonstrates the ability to differentiate %F of pregnant women based on physical activity levels. PPAQ is recommended to assess physical activity level in pregnant women and to support health promotion messages to encourage adequate physical activity during pregnancy.

Keyword: APCAPS-PAQ, percentage body fat, PPAQ, pregnancy, physical activity

PAB(T2)-142

Nutritional and hydration strategies during 160 km ultramarathon race between hypoglycemic and normoglycemic runners

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Background and objectives: Ultramarathon race is a sporting event that is growing in popularity. Nutritional demand in an ultramarathon race is physiologically enormous, and it should not be surprising that the energy intake of runners cannot reach energy expenditure. Hypoglycemia is an often-observed phenomenon even in runners ultimately finish. While many factors can contribute to this phenomenon, this paper investigated the relationship between running performance and nutritional strategies, which play a large role in maintaining normal glycemia.

Methods: Twenty-two ultramarathon runners took part in the study. The glucose profile was monitored continuously throughout the race, which was divided into nine segments by timing gates. Running speed was monitored by GPS throughout the race and standardized to the average of the top five finishers for each gender. Food and drink intake during the race were recorded, and carbohydrate, protein, fat, water, and sodium intake were calculated.

Results: Hypoglycemia was observed in 3 runners, and disturbance of glycemia was observed in 8 runners. Nutrient intake varied widely among individuals, and what was sufficient to maintain blood glucose in one runner could cause a disturbance in glycemia in another runner. Energy and nutrient intakes for each runner are in the state under calculation and will be reported in the poster presentation.

Conclusion: The present study demonstrates that continuous glucose monitoring could be practical to guarantee optimal carbohydrate intake for each ultramarathon runner to compensate for individual differences in nutritional and metabolic characteristics.

Keyword: Sports nutrition, CGM, Continuous glucose monitoring, Carbohydrate, Endurance exercise

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-143

Assessment of anemia and other micronutrient deficiencies among 0.5–11-year-old children in 2020-2021: results from SEANUTS II Vietnam

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Background and objectives: Despite being important for a healthy growth and development, not much information is available on the micronutrient status of children. The 2nd South East Asian Nutrition Surveys (SEANUTS II) is a cross-sectional survey conducted in Indonesian, Malaysian, Thai, and Vietnamese children. SEANUTS II aims to get an in-depth understanding of the nutritional status, dietary intake, and lifestyle behaviors in children between 0.5-12.9 years old. The objective of this study is to assess the prevalence of anemia and deficiencies of vitamin A, vitamin D, iron, and zinc in Vietnamese children.

Methods: 4001 children aged 0.5–11.9 years old in a nationally-representative sample were recruited from September 2020 to April 2021. Blood samples were collected from 1054 children. Hemoglobin levels were measured via HemoCue, ferritin and C-reactive protein via immunoturbidimetric method, retinol and vitamin D via LC/MS/MS, and zinc using flame atomic absorption spectrophotometry.

Results: Weighted results showed that overall, 12.0% the children had anemia which can be classified as mild level of public health issue. More rural children had anemia compared to their urban counterparts (13.9% versus 9.1% resp.). Especially children <1 year old were affected with anemia (38.6%), which can be classified as moderate level of public health issue. The prevalence of sub-clinical vitamin A deficiency in children aged 4-11.9 years old was 6.2%, classified as mild level of public health problem. The prevalence of vitamin D deficiency (25(OH)D<25 nmol/L) and insufficiency (25(OH)D between 25–49.9 nmol/L) being 0.69% and 31.1% in children, resp. Prevalence of serum zinc deficiency was 60.8%, classified as severe level of public health problem. Less than 1% of the children had low iron stores (corrected for inflammation).

Conclusions: Anemia and micronutrient deficiencies are common in Vietnamese children. Implementing effective solutions to fight against anemia and micronutrient deficiencies to improve the micronutrient status of the groups at risk is essential.

Keyword: anemia, micronutrient deficiencies, children, Vietnam, SEANUTS II

Conflict of Interest Disclosure: None of the authors or the research institutes has a conflict of interest

Further Collaborators: The study was funded by FrieslandCampina.

PAB(T2)-144

Ingredient statements as a tool for better understanding of use of packaged foods in the U.S.

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Background and objectives: Highly-processed foods have been linked to negative health outcomes, though the mechanisms are not still fully understood. Ingredients such as added sweeteners, intense flavorings, and chemical additives are some of the proposed mechanisms. Recently a new system, IngID was developed for parsing and systematic reporting of ingredients, including a thesaurus of over 30,000 uniquely listed ingredients. The objective of this report is to assess its capabilities and limitations, using sweeteners - nutritive and non-nutritive to illustrate.

Methods: We identified over 300 uniquely-listed sweetener-type ingredients associated with over 75 different types of sweeteners in selected sweet bakery products and sweetened beverages (top-sources of added sugars in the U.S. diets) categories, and broadly grouped them by calorie content. We quantified occurrence of different types of sweeteners, and proportion of foods containing them across categories, number of sweeteners used in each product and their co-occurrence. Tracking use of different sweeteners is of interest due to their differential effects on the body.

Results: Sucrose, dextrose, and high fructose corn syrup are among the top listed sweeteners, all nutritive; their extent of use varies by category. Use of multiple sweeteners in a product is common. Non-nutritive sweeteners are used in 2% of cookies and pastry products, but much more common in beverages. The most common types are acesulfame potassium, aspartame, and sucralose. Weighting by volume of point-of-sales data and amounts of sweeteners used in each product may potentially impact the list; however, these data are not publicly available. Similarly, we are unable to assess per-capita intakes of total or specific type of sweeteners, as such details are not available in the food composition databases used for national dietary surveys.

Conclusions: IngID provides tools to help improve our understanding of packaged foods, not possible before. It can contribute to improved food composition databases, dietary assessment tools, and study of interaction of ingredients. However, more publicly available databases/tools are needed for better understanding of dietary intakes of different ingredients and eventually diet-health-disease relationships.

Keyword: packaged food, ingredients, BFPD, IngID, food ontology

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T2)-145
Changes in child dietary practices in food secure and insecure areas during COVID pandemic in Nepal

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Background: Global evidence suggests a strong association between food insecurity and malnutrition. The COVID-19 pandemic has exacerbated the challenges faced by vulnerable communities. The objective of this study was to explore the association between food insecurity and infant and young child feeding practices in both food secure and insecure areas of Nepal during the COVID-19 pandemic.

Methods: We used data from a cross-sectional rapid assessment survey on child nutrition collected via mobile phones in January 2022 supported by USAID. Respondents included 23,471 randomly selected mothers with children less than 24 months from 117 food insecure and 272 food secure (total 389) of Nepal's 753 municipalities. The three outcome variables were exclusive breastfeeding among children 0-6 months, minimum acceptable diet among children 6-24 months, and minimum dietary diversity (5 or more out of 8 food groups) among children 6-24 months. The primary exposure variable was the impact of the COVID-19 pandemic on household food security based on mothers reporting experiencing limitations in their food consumption due to the COVID-19 pandemic. We applied a logistic regression model adjusted for socio-economic confounders for food secure and insecure areas, respectively, to test the association between households reported food security status with the three child feeding outcomes.

Results: Among surveyed households, approximately 27% faced food insecurity due to COVID-19. In the adjusted models, we found that reporting experiencing food insecurity was inversely associated with exclusive breastfeeding of children less than 6 months (OR=0.72, CI: 0.55 to 0.94), children 6-23 months meeting the minimum dietary diversity (OR=0.75, CI: 0.65 to 0.85), and children 6-23 months meeting the minimum acceptable diet (OR=0.79, CI: 0.69 to 0.90) in the food insecure areas. However, in food secure areas, this association was only significant for exclusive breastfeeding among children less than 6 months (OR=0.64, CI: 0.54 to 0.75).

Conclusion: The findings of the analysis suggest that existing vulnerabilities are exaggerated during crises like pandemics with unequal consequences on child dietary practices. Future efforts should focus on improving food security and resilience of households in food insecure areas to minimize the impact of future crisis on child nutrition.

Keyword: food insecurity, infant and young child feeding, COVID-19, Nepal

Conflict of Interest Disclosure: NA

Further Collaborators: NA

PAB(T2)-146
Anemia and determinants of hemoglobin concentration in women of reproductive age in Senegal: results of a national cross sectional survey

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Background and objectives: Anemia is a major public health problem, particularly in developing countries, and has adverse effects on the health of women. Generally, the causes of anemia are related to nutritional deficiencies, infectious diseases or hemoglobin disorders. This study aimed to determine the national prevalence of anemia and the determinants of hemoglobin concentration among the women of reproductive age (15-49 years).

Methods: A national cross-sectional study was conducted and data were collected from 1012 women. Biomarkers measurement including hemoglobin, plasma ferritin, plasma folates, C-reactive protein and alpha-1 acid glycoprotein were measured. Clinical health data were also collected. Plasma ferritin was adjusted for inflammation. Association between hemoglobin concentration and adjusted plasma ferritin, plasma folates, and physiological status (pregnant, breastfeeding, and nonpregnant/nonbreastfeeding) of women was measured using multivariate linear regression models.

Results: The prevalence of anemia was 47.6% among women and was significantly different between physiological status of women ($p < 0.001$). In a bivariate analyses, low adjusted plasma ferritin ($p < 0.001$), low plasma folates ($p < 0.007$), and being pregnant women ($p < 0.001$) were negatively related to hemoglobin concentration. These significant variables were included in a multivariate model. Even though, low plasma folates were associated with low hemoglobin concentration in the bivariate analysis, it did not become significant in the multivariate analysis nevertheless the model predict 29% of variance of women's hemoglobin concentration.

Conlusion: Such covariates underpin rates of low hemoglobin concentration among Senegalese women. Our results are not consistent with those reported by Al Khatib et al (2006) in a Lebanese study establishing a strong association between anemia, iron deficiency and folate deficiency. These authors have shown that anemia not related to iron deficiency is mainly explained by folate deficiency in women of childbearing age. Policies and programs should be design specifically to target vulnerable who bear the burden of anemia.

Al Khatib L, Obeid O, Sibai AM, Batal M, Adra N, Hwalla N. Folate deficiency is associated with nutritional anaemia in Lebanese women of childbearing age. Public Health Nutr 2006; 9 (7): 921-927

Keyword: anemia, ferritin, folates, women, Senegal

PAB(T3)-1
Relationship Between Balanced Meals, Energy, and Nutrient Intake in Female University Students

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Background and objectives: The Basic Plan for Shokuiku (Food and Nutrition Education/Promotion) by the Japanese government aims to increase the percentage of Japanese who eat at least two balanced meals daily. Each balanced meal includes a grain dish, a fish or meat dish, and a vegetable dish, and should be eaten almost every day. However, in recent years, the number of young people practicing this eating habit is decreasing. We aimed to examine the relationship between balanced meals, energy, and nutrient intake in young female university students.

Methods: From 2016 to 2018, we conducted a 3-day diet survey using a weighing method and a questionnaire for third-year female University students during the months of June. Of 102 participants, we excluded those who did not respond to the survey (n=8). Data from the remaining 94 participants were analyzed with a recovery rate of 92.1%. A balanced meal was defined in accordance with the Japanese Food Guide Spinning Top. Participants who consumed at least 1 serving from each meal category were considered to have consumed balanced meals. Participants were classified into two groups based on what they ate during the 3-day survey period. The "high" and "low" groups comprised those who had at least four and less than four balanced meals during the 3-day survey period, respectively. Twenty-three items were examined by the weighing method, including energy, proteins, lipids, cholesterol, carbohydrates, dietary fibers, 10 vitamins, and 7 minerals.

Results: First, the median numbers of meals consumed during the 3-day period were seven grain dishes, six fish and meat dishes, five vegetable dishes, and four balanced meals. Second, compared with the "low" group, the daily intake of 22 out of the 23 items, excluding vitamin A were higher in the "high" group. Lastly, compared with the "low" group, a smaller number of participants in the "high" group answered that they "want to lie down," "cannot keep up with work," or "feel tired."

Conclusions: Findings from this study suggest that to help young people eat balanced meals, it is necessary to develop a program that encourages them to eat side dishes more frequently.

Keyword: Balanced Meals, Female University Students, Energy and Nutrient Intake, Symptoms of Fatigue

PAB(T3)-2
Age and gender differences in the relationships among self-rated health, dietary habits, and preventive behavior for lifestyle diseases in Japanese 30-50s.

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Background and objectives: Self-rated health is correlated with objective health indicators, and has been shown to be an independent contributor to mortality and morbidity. To investigate the association between self-rated health and dietary habits, we performed a secondary analysis of the data in the 'Survey of Public Awareness for Nutrition and Food Education' conducted by the Cabinet Office.

Methods: Targeting 30-59 years old, "interest in food education", "basic knowledge about food safety", "mind for a healthy diet", "subjective economic status", "time to spare", "self-rated health" and "preventive behavior for lifestyle diseases" were extracted, and covariance structure analysis was performed by age and gender variations.

Results: Dietary factors had a positive effect on "self-rated health" in each age group, but the effect was more pronounced in women than in men. In women, the positive effects of "subjective economic status" and "time to spare" on "preventive behavior for lifestyle diseases" were more pronounced than in men. The interfactorial correlation for dietary factors was significant in women of all ages, and was more significant in men of 40s and 50s than 30s.

Conclusions: It was suggested that more appropriate health-guidance and health-promotion supports were needed according to the age and gender of the subjects.

Keyword: self-rated health, prevention of lifestyle diseases, dietary habits, health literacy, nutrition and food education

PAB(T3)-3
Diet and quality of sleep in pandemic in adults from 20 to 30 years.

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Background and objectives: The pandemic brought with it changes that impacted the quality of sleep and eating patterns around the world. Different processes such as food intake participate in the regulation of sleep, which may suggest a relationship between food and sleep. The objective is to evaluate the relationship between the quality of sleep and diet in times of pandemic in the population of 20 to 30 years of Peru.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: A cross-sectional study was carried out with 105 adults, between 20 and 30 years of age. The Pittsburgh Sleep Quality Index (PSQI) was used to measure the subjective quality of sleep and a survey called the "Healthy Eating Assessment" of the Canadian government, which identifies eating patterns. Both surveys were carried out in Google Forms, they were distributed through social networks and the results were transferred to Excel. For the statistical analysis, the STATA 12.1 program, pairwise correlation, was used to correlate the surveys and their components with the level of significance taken as $p < 0.05$.

Results: A significant relationship was found between a better quality of sleep and diet in the study; In addition, there was no positive correlation with the consumption of sugary drinks and sweets, which resulted in a worse quality of sleep with higher consumption. On the other hand, dairy products, including milk, sugar-free yogurt, and low-fat cheese, had a higher significance (P=0.0007) possibly due to their tryptophan content related to a better quality of sleep. Finally, sleep components such as subjective quality (P=0.0131) and sleep duration (P=0.0288) also obtained a strong significance regarding a good diet.

Conclusions: There is a good relationship between sleep quality and diet. The intake of dairy products, probably due to the content of tryptophan, is related to better sleep results. No positive correlation was found between the consumption of sugary drinks and sweets with sleep quality.

Keyword: Sleep quality, Tryptophan, Diet quality

PAB(T3)-4
A study on leftover food waste resulting from school lunch menu-related factors

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Background and objectives: Japanese school lunches provide excellent teaching material and are known to have good nutrient balance. Traditional Japanese food and dishes made with a variety of local products are served. However, the amount of leftover food is large. This study aimed to identify factors related to leftover food from school lunches.

Methods: Amounts of leftover food from school lunches provided at A primary school in Okayama Prefecture from April 2020 to March 2021 (n=187) were used for the analysis. Principal component analysis was performed on the usage of each food group in provided menus to classify school lunch menu features. The leftover rate of staple foods, milk and three side dishes which were served in cans were analyzed using Kruskal-Wallis tests.

Results: Two main factors were extracted for the provided menus: i) type of food group of Japanese style dishes consisting of rice, seaweed, small fish; and ii) type of food group of main dishes, either fish/shellfish or meat. The two factors were categorized into four groups. The leftover rate of Japanese-style fish dishes was significantly higher than that of Western meat dishes in all cans. Comparing the leftover rate of cans between semesters, the rate of leftover staple foods and side dishes decreased in the third semester compared to the first semester. The rate of leftover milk, on the other hand, increased in the third semester.

Conclusions: We confirmed that the menus were provided in accordance with the school lunch policy of the local government. The leftover rate of Japanese dishes with fish tended to be higher than that of Western dishes with meat. In addition, the amount of leftover food, including staple foods and side dishes, decreased in the third semester compared to the first semester. This might indicate dietary education effects throughout the year, increased daily intake by children as they grow and seasonal effects. The findings suggest that leftovers can be controlled through dietary education and ingenuity in the combination of ingredients and dishes.

Keyword: leftover, school lunch, Japanese dishes

Conflict of Interest Disclosure: no

PAB(T3)-5
Moderate to vigorous physical activity in daily life of Japanese children with Down syndrome is shorter than that of normal children

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Background and objectives: The World Health Organization (WHO) recommends at least 60 minutes of moderate to vigorous physical activity (MVPA) for children with and without disabilities. Children with Down syndrome (DS), many of whom have congenital heart diseases, have physical characteristics such as muscle hypotonia. They may also have characteristics that differ from those of normal children (NC) in terms of physical activity intensity and duration as well as ambulation. This study aimed to compare the time characteristics of physical activity considering both ambulatory and non-ambulatory states between children with DS and NC.

Methods: Participants included 69 fourth- to sixth-grade children with DS and 68 NC attending elementary schools in Japan. The physical characteristics recorded were age, height, weight, and body mass index. Physical activity was recorded as follows: Sedentary behavior (PA < 1.6 MET) time, Light physical activity (1.6 MET ≦ PA < 3.0 MET) time, Moderate physical

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

activity (3.0 MET ≦ PA < 6.0 MET) time, Vigorous physical activity (6.0 MET ≦ PA) time, and MVPA (3.0 MET ≦ PA) time. Walking and non-walking conditions and the number of steps were analyzed as well. Student's t-test and Welch's t-test or the Mann–Whitney test was used for analysis.

Results: Children with DS had a longer MVPA time in non-ambulation than NC (27.7 vs. 24.1 min/day; p=0.035). The total MVPA time was shorter (DS: 53.1 min/day, NC: 65.0 min/day; p=0.003) owing to the shorter MVPA ambulation time (DS: 25.5 min/day, NC: 40.9 min/day; p<0.001). Thirty-three percent of the children performed > 60 minutes/day of MVPA as recommended by the WHO.

Conclusions: Children with DS were able to maintain the same amount of non-ambulatory MVPA time as NC. It is hoped that children with DS will achieve the WHO-recommended MVPA time of 60 minutes with the promotion of ambulatory activities through play and other activities.

Keyword: Japanese elementary school students, Down syndrome, MVPA, WHO, 3-axis accelerometer

PAB(T3)-6
Evaluation of physical condition in long-distance runners by using blood test and dietary surveys

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Background and objectives: Physical condition, including exercise anemia, affects the competition performance of athletes. It has been reported that low serum ferritin affects endurance performance and increases the risk of injury. Ferritin levels are reflective of iron stores, which are used for enzyme synthesis involved in energy production. This study aimed to evaluate physical condition in terms of serum ferritin level and dietary intake with the aim of improving competition performance and preventing injuries in long-distance runners.

Methods: The participants were 21 male long-distance runners at OE University. Before training, we measured body weight and body composition and evaluated the blood test data and dietary intake. This research was conducted from April to November in 2021.

Results: Body weight did not significantly differ between June–July and October–November, but body fat percentage in June–July was lower than that in October–November. The proportion of participants with a BMI <18.5 was 17.6% in June–July and 23.5% in October–November. The median serum iron levels of runners were within the normal range, but 31.3% of runners in June–July and 25.0% of those in August–September were below the normal range. Median hemoglobin levels were within the normal range, but 12.5% of runners in April–September and 25.0% of those in October–November were below the normal range. Median ferritin levels were within the normal range, but the proportion of runners below the normal range increased from June to September (37.5%) and then decreased in October–November. The median MCHC level was below the normal range in June–July, and 56.3% of runners were below the normal range in June–July. In the dietary survey, the percentage of participants who consumed all staple foods, main dishes, and side dishes was 36.8% for breakfast, 26.3% for lunch, and 57.8% for dinner. Only 37.0% of runners had pre- and post-game meals.

Conclusions: The results suggested that long-distance runners have lower serum ferritin and serum iron levels in the summer. Nutritional support may be necessary to ensure that runners have a balanced breakfast and lunch as well as pre-game meals.

Keyword: Nutrition, Exercise anemia, Long-distance runner

PAB(T3)-7
Pasta Intake in the Elderly:Results of an Eating Survey of Residents of a Long-Term Care Health Facility and Community-dwelling Elderly who Attend a Day Care Rehabilitation Center

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Background and objectives: Japan is a super-aging society and the population of elderly people aged 65 and over is growing rapidly every year. According to the National Health and Nutrition Survey of 2016, the intake of pasta as a proportion of total food intake decreases with age. In this study, we conducted an eating survey to investigate the preference for pasta in elderly people in Japan.

Methods: The study participants were 34 residents of a long-term care health facility in Kyoto City (age 88.4±5.2 years) and 105 community-dwelling elderly people who attend a day care rehabilitation center at the same facility (age 82.4±9.1 years). From April to November 2018, pasta or rice and fried *udon* noodles were served as staple meals at the long-term care health facility, and eating surveys were conducted using the weighing method. In addition, we created a mackerel tomato pasta dish for the community-dwelling elderly participants, served this dish along with side dishes, and conducted eating surveys.

Results: According to the results of the eating surveys (conducted 10 times), 262 meals (81.9%) were completely consumed, and 58 meals (18.1%) were incompletely consumed (i.e., there were leftovers). Pasta intake rates were the same as rice intake rates, regardless of the type of pasta, the sauce used, or the season during which the dish was served. For participants on a soft diet, the leftover rate for pasta was higher, and there was a significant relationship between the meal type and leftover rate. In the first trial, the intake rate of the mackerel tomato

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

pasta dish was low, but this was improved by devising a cooking method for the pasta sauce.

Conclusions: The results suggest that elderly people requiring support care prefer pasta and that serving pasta might improve the variety and diversity of their diet.

Keyword: Elderly, Pasta intake, Eating survey of meals

PAB(T3)-8

'Got to eat right, because I live alone': Dietary practices among Japanese older women participating in a community walking program with nutrition lessons

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Background and objectives: Japan has the highest aging rate worldwide. In 2021, 29% of the total population were adults aged 65 years or older. Globally, it is estimated that by 2050 one in six people will be 65 years of age or older. There is emerging research interest on active and healthy aging, specifically, physiological, and psychosocial factors that may play a role in nutrition and food choice of older adults. This study explored the integrated role of nutrition and physical activity for active, healthy aging. We examined dietary practices and perceptions of food choice among older Japanese women who participated in a community walking program (June ~ July 2021).

Methods: The community walking program offered a dietary assessment and three 15-minutes group nutrition lessons for the participants. Dietary intake was assessed by a food frequency questionnaire (Eiyo-Kun FFQg). Body weight and height were measured at a community center when the walking program started. Demographic information was collected by the questionnaire. After the program ended, one-on-one semi-structured interviews were conducted with nine participants who had completed the walking program. Interview questions focused on eliciting a better understanding of how the walking program impacted participants' dietary practices.

Results: Participants' mean age was 72 years and the body mass index was ranging between 18.0 and 25.1 kg/m^2. Four women were living alone. All participants met the reference values of all macro- and micronutrient intakes. This qualitative evaluation helped to obtain a richer understanding of community participants' reasons for wanting to be healthy as they age, and the benefits of the program on participants' experience of motivation to have healthier food choices (i.e., food acquisition, preparation, and cooking). Interestingly, women living alone helped motivated themselves to be healthy by providing a sense of 'got to eat right, so I will be healthy and strong.'

Conclusions: This study provides insight into active, healthy older participants' experiences of community walking program with short nutrition lessons. Further research in a broader population of older adults is mandated to determine the efficacy of integrated role of nutrition and physical activity using community walking programs.

Keyword: Healthy aging, Nutrition, Physical activity, Dietary practices, Japanese older women

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T3)-9

Effects of supplementary intake of milk protein in combination with resistance exercise training on lean body mass in female university students

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Background and objectives: Increasing lean body mass (LBM) during youth is important to prevent sarcopenia and locomotive syndrome in their future. This study investigated the effects of the supplementary intake of milk protein in combination with resistance exercise training on LBM in female university students.

Methods: Thirty female university students (BMI: 19.8±2.0 kg/m^2) were recruited and asked to perform bodyweight-based and elastic tubing-based resistance exercises 4 days a week for 12 weeks. During the training period, subjects were instructed to consume cookies containing either 10 g of milk protein (MP: n=15) or isoenergetic carbohydrate (CON: n=15) daily. At 1 week before and 12th week of the interventions, subjects were required to complete 3-day food diary to determine their daily macronutrient intake. Body composition and muscle thickness were respectively measured by bioelectrical impedance analysis and B-mode ultrasound imaging before and after the interventions.

Results: Twenty-one subjects (CON: n=9; MP: n=12) successfully completed the 12-week nutritional and training interventions. Because of an unexpected increase in dietary protein intake during the interventions in the CON group, protein as well as energy intakes during the interventions did not differ between the two groups ($p<0.05$). LBM, lower-limb muscle mass, and quadriceps muscle thickness were significantly increased with training in the MP group, but not in the CON group, with the increases in the MP group being greater than those in the CON group ($p<0.05$).

Conclusions: Our results suggest that the supplementary intake of milk protein during resistance exercise training may be an effective nutritional strategy to increase LBM in young. Given that the MP and CON groups had similar protein intakes during

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

the interventions, such an increase in LBM in the MP group may be attributed to the quality rather than quantity of milk protein.

Keyword: milk protein, resistance exercise training, female, university students, lean body mass

Conflict of Interest Disclosure: This study was funded by Meiji Co., Ltd (Tokyo, Japan). The supplement cookies used in this study were provided by Meiji Co., Ltd. Kentaro Nakamura and Atsushi Kanda are employees of Meiji Co., Ltd., but were not involved in obtaining or analyzing the data.

PAB(T3)-10
Eating habits and lifestyle-related salty taste preference in early childhood

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Background and objectives: Reducing salt intake is an important dietary issue in Japan. The purpose of this study was to investigate salty taste preference of everyday foods in young children and to examine whether it is affected by eating habits and lifestyle.

Methods: This study was carried out from December 2018 to February 2019 at kindergartens located in Osaka and Shiga prefectures, Japan. A total of 176 children aged 4-6 years participated in a salty taste preference test. The children tasted bonito broth with two different salt concentrations (0.8% and 1.2% NaCl: CON and SAL, respectively) and were asked which one they preferred. In addition, their parents were asked to complete a self-administered questionnaire covering basic items such as their child's physical characteristics, as well as items on their child's food intake frequency (15 questions), awareness of the child's diet (11 questions), and problems with meal preparation and the child's meals (13 questions).

Results: CON was preferred by 89 children (35 boys, 54 girls) while SAL was preferred by 54 (31 boys, 23 girls). The remaining 33 children (22 boys, 11 girls) did not answer clearly and were excluded. SAL was preferred by a significantly higher percentage of boys than girls. Height and weight were significantly lower in the SAL group than in the CON group. Childcare hours in kindergarten, frequency of attending kindergarten on Saturdays, and frequency of school lunch were significantly lower in the SAL group than in the CON group. The percentages of parents responding to “My child prefers sweet drinks and sweets” and “My child won't eat food that isn't strongly seasoned” were significantly higher in the SAL group than in the CON group.

Conclusions: These results suggest that gender and eating habits including school lunch are related to children's salty taste preference. It is necessary to support parents of kindergarteners in improving the eating habits of children who prefer salty foods.

Keyword: Salty taste preference, Early childhood, School lunch, Eating habits, Questionnaire survey

PAB(T3)-11
More underweight men and overweight women? A cross-sectional study in older adults experiencing food insecurity in Gasabo district, Kigali, Rwanda

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Background: In an aging global population, improving nutrition status of older adults can contribute to healthy aging. There is a lack of data on older adults' nutrition status living in urban settings in low- and middle-income countries.

Objective: To assess the prevalence of malnutrition and associated factors among older adults aged 55 years and older in Gasabo district, Kigali, Rwanda.

Method: This cross-sectional survey was conducted between November 2021 and February 2022. Trained nutritionists collected socio-demographic data and captured anthropometric measurements. The Food Insecurity Experience Scale (score ranging from 0-8) was used to capture moderate and high food insecurity (cut-offs >3). Poverty was assessed using Rwanda's wealth categories, locally known as UBUDEHE categories (ranging from 1-4), where the lowest 2 categories are defined as poor. Cut-offs were <18.5 kg/m^2 for underweight and >24.9 to <30 and ≧ 30 kg/m^2 for overweight and for obesity, respectively. We present descriptive statistics and findings from multivariable logistic regression analysis with nutrition status (underweight vs others) as the dependent variable and age, sex, family size, wealth index, education level, and food insecurity as independent variables. Data were analyzed using STATA (version 17.0). Ethical approval was obtained in Rwanda and Norway, and local authorities provided the permission to conduct the study.

Results: Older adults (N=417) with an average (SD) age of 66.9 (8.9) years, mostly women n=314 (72.3%) were enrolled. Among women, n= 37 (11.7%) were underweight, whereas n=153 (48.7%) were overweight or obese. For men, the corresponding numbers were n=37 (36%) and 13 (12.6%). Food insecurity was high, n=297 (71%). We found that sex (Adj OR=7.2; 95% CI: 3.4, 15.4) and poverty (Adj OR=2.8; 95% CI: 1.2, 6.5) were associated with underweight after adjusting for age, family size, education level, and food insecurity.

Conclusion: There was a disparity in nutrition status where more men were underweight, and more women were overweight. Food insecurity was high among older adults, but poverty was associated with being underweight. Therefore, policy interventions should target improving the economic situation of older adults.

Keyword: Poverty, food insecurity, hunger, aging, undernutrition

Conflict of Interest Disclosure: Authors declare no conflict of interest.

PAB(T3)-12

Dietary Patterns and Predicted 10-year Cardiovascular Disease Risk in a Multiethnic Asian Population

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Background and objectives: Studies examining associations between dietary patterns and Framingham risk score (FRS) and predicted 10-year cardiovascular diseases (CVD) risk in an Asian population are lacking. This study aimed to identify *a posteriori* dietary patterns across three major ethnic groups in Singapore and ascertain their associations with locally modified FRS and predicted 10-year CVD risk.

Methods: This cross-sectional study included 8594 Singapore residents (aged 21–75 years) from the Singapore Multi-Ethnic Cohort. Data on sociodemographic and lifestyle factors were collected via questionnaires. Food consumption was assessed using a validated Food Frequency Questionnaire. Dietary patterns were identified using principal component analysis and associations with CVD risk factors, FRS and high predicted CVD risk (>=10%) were analysed using multiple linear and logistic regression.

Results: Four dietary patterns emerged. The 'processed food and sugar-sweetened beverages' pattern was significantly associated with higher FRS (B*eta*: 0.13; 95% CI: 0.04, 0.23), while the 'ethnic breads, legumes and nuts' (B*eta*: -0.13; 95% CI: -0.22, -0.04) and 'whole grains, fruit and dairy' (B*eta*: -0.17; 95% CI: -0.24, -0.10) patterns were significantly associated with lower FRS. The 'meat and vegetables' pattern was not significantly associated with FRS. Only the 'whole grains, fruit and dairy' pattern was inversely associated with high predicted CVD risk.

Conclusions: Adherence to the 'ethnic breads, legumes and nuts' and 'whole grains, fruit and dairy' patterns was associated with a lower predicted CVD risk, and an inverse association for the 'processed food and sugar-sweetened beverages' pattern in an Asian population. These findings can inform the development of culturally sensitive dietary interventions to prevent CVD.

Keyword: Asian, Dietary patterns, Adults, Framingham scores, Cardiovascular risk

Conflict of Interest Disclosure: None of the authors has a conflict of interest to declare.

PAB(T3)-13

Administration of human milk oligosaccharides during the early postnatal period ameliorates the behavioral alteration of offspring in a mouse model of perturbed maternal gut microbiota

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Background and objectives: The infants are colonized by the microbes they encounter in their environment, especially those vertically transmitted from their mothers. We have developed an animal model in which maternal gut microbiota is perturbed by exposure to non−absorbable antibiotics during the prenatal period (perturbed maternal gut microbiota model, PMGM model; Tochitani, 2016). The analyses on the PMGM model showed that the perturbation of maternal gut microbiota affected the postnatal brain development of offspring and caused an alteration in offspring behavior. In this study, we explored if the transmission of the perturbed maternal gut microbiota to the offspring is the cause of behavioral alteration of offspring by intervening the offspring gut microbiota with oligosaccharides.

Methods: We performed an intervention study by applying a mixture of oligosaccharides (2'-fucosyllactose, 3'-sialyllactose, 6'-sialyllactose) on P5−14 to the offspring of the PMGM model.

Results: Administration of oligosaccharides during the early postnatal period induced an alteration in the gut microbiota profiles in the offspring of the PMGM model and attenuated the spatial preference for the peripheral area in the unfamiliar field, which is a characteristic behavior of the offspring of the PMGM model.

Conclusions: 10 day-long intervention using a cocktail of oligosaccharides induced an alteration in the gut microbiota, which led to moderate normalization of offspring behavior. This result suggests that the offspring exhibit a behavioral alteration in the PMGM model, at least in part, because they have inherited the perturbed gut microbiota from their dams. This result also implies that human milk oligosaccharides administration can be utilized for dietary intervention on the gut microbiota of infants who have inherited the perturbed maternal gut microbiota.

Keyword: brain development, behavior, anxiety, gut microbiota, human milk oligosaccharides

Conflict of Interest Disclosure: This research is partly supported by a collaborative research grant from KYOWA HAKKO BIO CO., Ltd.

PAB(T3)-14
Provision of Meals to Toddlers at Nursery Schools (2) Focusing on Cooperation between Cooks and Childcare Workers

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Background and objectives: Following on from Report (1), Report (2) covers our study on the cooperation between the cooks and childcare workers in the provision of meals to toddlers aged approximately 18 to 36 months.

Methods: We adopted the same method used in Report (1). With regard to cooperation between cooks and childcare workers, cooks were asked to answer a question "Is information being shared with childcare workers on how children eat?" by selecting a response on a scale from 1 to 10 where 1 is "No sharing at all" through to 10 "Sharing a lot." Their answers were categorized into three groups based on the distribution, namely Low Group (LG) (1~5) 117 persons (25.9%), Middle Group (MG) (6, 7) 135 persons (29.9%) and High Group (HG) (8~10) 200 persons (44.2%), which were then analyzed using the chi-square test and the Kruskal-Wallis test.

Results: In terms of years of service, many belonging to the HG had worked for longer ($p=0.03$) than those in the other groups and were certified nutritionists ($p=0.01$). Those in the HG had a good understanding of the eating behavior of toddlers both at nursery schools ($p<0.01$) and in their homes ($p<0.01$). They also evaluated the reasons why meals had been, where applicable, unsuitable for children in a particular age bracket ($p<0.01$). Additionally, those in the HG were able to incorporate their understanding of eating behavior in the provision of meals ($p<0.01$). They prepared meals with attention to the size of servings which would help children to eat without adult assistance ($p<0.01$) and scored highly for clearly conveying to childcare workers the rationale underlying the methods used to cook the meals provided ($p<0.01$).

Conclusions: In the provision of meals to toddlers aged approximately 18 to 36 months, this study demonstrated the importance of sharing information between cooks and childcare workers on how children eat.

Keyword: Nursery school, Toddler, Provision of Meals

Conflict of Interest Disclosure: The authors declare no conflicts of interest associated with this manuscript.

This work was supported by KAKENHI (18K13122).

PAB(T3)-15
Provision of Meals to Toddlers at Nursery Schools (1) Focusing on Main Dietary Constituents

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Background and objectives: Few reports are available in Japan on the provision of meals at nursery schools to toddlers aged approximately 18 to 36 months, that is, children who have passed the weaning stage. Accordingly, the objective of this study was to obtain fundamental data on the provision of meals to children in that age bracket. Report (1) covers the analysis focusing on the main dietary constituents.

Methods: In October 2021, we sent a questionnaire to 776 nursery schools belonging to the Chiba Prefecture Child-Care Association, specifying the subject of survey as one person representing either nutritionists or cooks. Major contents of the survey comprised 1) whether meals in the post-weaning period are different from those for children aged three years or older, 2) where different, what steps are taken to devise and prepare meals appropriate for children aged between 18 and 36 months, and 3) whether steps are taken to process 22 food items which are difficult to chew and swallow.

Results and Conclusions: We collected answers from 490 nursery schools, which represents a response rate of 63.1%. The respondents' length of service at nursery schools was 9.8±10.3 years on average. Those certified as nutritionists accounted for 58.3%, and as national registered dietitians, 27.2%. Nursery schools that served meals to children aged three years or older that were different from meals in the immediate post-weaning period constituted 66.1%. Ranked in numerical order of number of responses, meals for older children were different in terms of quantity, hardness, cooking method, types of foodstuff and stickiness. Of 22 food items which are difficult to chew and swallow, those for which 80% or more of respondents devised ways to prepare these foods included root crops, green vegetables, brassicas, mushrooms, apple, seaweed such as *wakame* (*Undaria pinnatifida*) and *hijiki* (*Hizikia fusiforme*), dried Japanese white radish strips, *abra-age* (deep-fried tofu) and tomatoes and beans with skin. These findings suggest that these foodstuffs require special attention when provided as part of a post-weaning diet.

Keyword: Nursery school, Toddlers, Provision of Meals

Conflict of Interest Disclosure: The authors declare no conflicts of interest associated with this manuscript. This work was supported by KAKENHI(18K13122).

PAB(T3)-16
Effect of Integrated Maternal Nutrition Interventions on Birth Weight – a retrospective quasi-experimental study

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Background: Maternal malnutrition during pregnancy is the main determinant of LBW. Appropriate nutrition interventions during pregnancy are key to improve maternal nutrition and birthweight of their newborns. USAID/Rwanda's flagship nutrition project, Gikuriro, promoted intakes of healthy and balanced diet among pregnant women. Households with pregnant women were targeted with nutrition sensitive interventions including promotion of bio-intensive agriculture, Savings and microcredits, and improved WASH services. This study compares birth weight of children born to mothers exposed to these interventions with controls from non-intervention districts.

Methods and Materials: Applying a quasi-experimental study design, quantitative data was collected from women who delivered in public health facilities across two intervention districts (Kayonza and Kicukiro) and two control districts (Gisagara and Gasabo) using standardized tools and between November 2020-June 2021. Sample size was estimated at 1144 (572 mother-newborn pairs for each study group). Trained nurses conducted weight measurements for the newborns and their mothers (MUAC) within 24hours after delivery and maternal hemoglobin was assessed using results from routine labor admission tests. Maternal BMI during the first trimester were extracted from antenatal care records. Data analysis was conducted using SPSS version 25.

Results: LBW was significantly higher among control(10.3%) compared to intervention group (3.4%) ($p < 0.001$). Similarly, maternal anemia was significantly higher among control (23.7%) than intervention group (10.5%). Furthermore, the proportion of maternal MUAC less than 23cm was higher among control group (14.5%) compared to intervention group (3.4%; $p < 0.001$). More women in the control group had low BMI in the first trimester (5.5%) compared to the intervention group (1.8%) ($p=0.010$). The proportion of women consuming less than 3 meals per day was significantly higher in the control group compared to the intervention group (28.4% vs 14.0%; $p<0.001$) and the proportion of women eating less than 5 food groups was higher in the control group than intervention group (25.7% vs 18.3%; $p=0.003$). The mean birth weight was 3.22kg in the intervention group against 2.99kg in the control group. This difference was significant with average 219 grams increase among intervention group ($p<0.001$).

Discussion and Conclusion: Findings from this study revealed that babies born to pregnant women who participated in the integrated nutrition interventions had better birth weight outcomes with an average 219g increase compared to those without exposures. Similarly, mean maternal hemoglobin, MUAC, BMI, and dietary diversity scores were significantly higher among the intervention group compared to controls. We can conclude that integrated nutritional interventions including nutrition education/counseling, agricultural promotion, savings and microcredit schemes, and improved access to WASH services can significantly improve birth weight.

Keyword: Low Birth Weight, Maternal Nutrition, Gikuriro, MUAC

Conflict of Interest Disclosure: The authors declare no conflict of interest associated to this effort

PAB(T3)-17
Amorphous calcium carbonate can delay bone loss in postmenopausal women by regulating bone turnover markers

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Background and objectives: The organic matter in the bone structure is protein, and the inorganic matter is composed of a variety of mineral salt deposits. Therefore, if the amount of certain nutrients in the diet is inappropriate, it will affect the balance of bone metabolism and cause bone loss.

Methods: This study was to use human clinical trials to evaluate the changes in bone quality of UIC amorphous calcium carbonate to achieve the assessment of osteoporotic function. In this experiment, 35 postmenopausal women were recruited to conduct a randomized double-blind clinical trial of bone mineral density measurement. They were divided into experimental group and control group, and they were treated with UIC amorphous calcium carbonate or placebo for 6 months.

Results: The results found that after the intervention of amorphous calcium carbonate, the bone density in the greater trochanter and the total bone density is statistically better than the placebo group. The bone turnover markers, bone alkaline phosphatase (BAP) and procollagen-I N-terminal propeptide (P1NP) of osteoblasts, are significantly better than the placebo group ($p < 0.05$).

Conclusions: Consuming UIC amorphous calcium carbonate may "Benefit to delay bone loss."

Keyword: amorphous calcium, osteoporosis, menopause, bone density, osteoblast indicators

Conflict of Interest Disclosure: N/A

PAB(T3)-18

Anthropometric assessment of relationship between dietary intake status of mothers and children: Similarity between dietary intake of mothers and children in overweight group is weak

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Background and objectives: The purpose of this study is to examine the relationship between the dietary intake status of mothers and children to determine specific methods of nutrition and dietary guidance based on an anthropometric assessment.

Methods: 146 pairs of 3- to 5-year-old children and their mothers from nursery schools in Ward A, Tokyo, were included in the study; 52 pairs with available results of the mother-child survey were included in the analysis. The survey items were nutrition, food intake, and height and weight measurements. The children were divided into three groups based on their BMI percentile: standard body weight group (25–75 percentile), underweight group (0–25 percentile), and overweight group (75–100 percentile). This study was approved by the review board of Wayo Women's University.

Results: There was no significant difference in the intake status of the children in terms of nutrients and food groups among the three groups. There was no significant difference in the intake of carbohydrates %E and lipids %E of the mothers among the three groups. Analysis of the association between the dietary intake of mothers and children showed a significant positive correlation in the standard body weight and underweight groups for the total energy intake; however, there was no correlation in the overweight group. The standard body weight group had a significant positive correlation for the intake of vegetable protein %E, potassium, magnesium, iron, vitamin D, vitamin C, dietary fiber, and salt equivalent; by contrast, the overweight group had no significant correlation. Notably, the overweight group had a significant positive correlation for the intake of cereals. All three groups had a positive correlation for the intake of green and yellow vegetables.

Conclusions: There was no significant difference in the intake of nutrients and food groups among the three groups of children. Analysis of the relationship between the dietary intake of mothers and children indicated a strong similarity in the standard body weight group but not in the overweight group. It is important to focus on the difference between the eating habits of mothers and children for nutrition guidance, particularly in the overweight group.

Keyword: anthropometric assessment, mothers, children, dietary intake status

PAB(T3)-19

Comparative profile of free fatty acids and the metabolites between different species and search for the critical enzymes to the lipid composition

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Background and objectives: On the basis of developmental origins of health and disease (DOHaD) theory, the milk quality during early infancy has obvious significance on the future health. In this study, we focused the profile of free fatty acids (FFAs) and the metabolites in ingested milk, because FAAs are high bioavailability lipids and lipid mediators, the metabolites from polyunsaturated fatty acids (PUFAs), are important for homeostasis or disease risks. Firstly, lipidomic profiles of human, cow and mouse milk were compared. Secondly, expression changes of the related enzymes were analyzed serially during the development of mouse mammary gland to identify the critical ones determining lipid composition.

Method: The lipid components were extracted from human, cow, and mouse milk using modified Bligh and Dyer method. Lipidomic analysis of the components was performed by liquid chromatography-electrospray ionization-mass spectrometry (LC-ESI-MS). Gene expression during the development of mouse mammary gland was measured by real-time PCR.

Result: Human milk had more abundant free fatty acids, and especially PUFAs compared with cow milk. The ration of ω3 PUFA (eicosapentaenoic acid: EPA and docosahexaenoic acid: DHA) to ω6 PUFA (arachidonic acid: ARA) in human milk was 1:1 but that in cow milk was 1:4. And human milk had more ω3 PUFA metabolites, however, cow milk had far ω6 PUFA metabolites. Additionally, EPA-derived 18-hydroxyeicosapentaenoic acid (18-HEPE), one of the specialized pro-resolving lipid mediators, was detected highly in human milk, but not in cow milk. Comparison of the lipidomic analysis indicated that the profile of mouse milk was similar to that of human milk. Among phospholipases involving in FFAs release and synthases of lipid mediators of PUFA metabolites, some correlated enzymes with the development of mammary gland were identified.

Conclusion: The present lipidomic analysis suggested that component balance of PUFAs and lipid mediators in human milk was superior in development of healthy body and avoidance of future disease risks. Some of phospholipases and lipid mediator synthases may be involved in the balance of milk lipid composition.

Keyword: milk, mammary gland, lipidomics, polyunsaturated fatty acid, lipid mediator

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-20

Thoughts about Body Shape and Eating Habits Influencing Adolescents' Body Perception Using the Health Behavior of School-age Children Questionnaire in Niigata Prefecture, Japan

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Background and objectives: In Japan, a significant proportion of young women are underweight (body mass index < 18.5kg / 5 kg/m^2). Underweight pregnant women are more likely to have children with low birth weight and subsequent lifestyle-related disorders. Adolescence is a crucial period for attaining maximum bone mass, and excessive dieting during this period may have a deleterious effect on bone health. Another concern in Japan is the recent increase in underweight adolescent boys. This study aimed to clarify the characteristics of adolescent boys and girls' attitudes, who live in Japan's major cities, toward their bodies and eating habits when they believe that they are "fat". Adolescents in this survey were aged 15–18 years, the same age range as Japanese high school students.

Methods: A cross-sectional survey was conducted on 1,343 boys and girls from the Niigata Prefecture, Japan, in September 2021. The questionnaire was adapted from a World Health Organization survey on the health behavior of school-age children. This study complied with the Helsinki Declaration and was approved by the institutional review boards of the Niigata University of Health and Welfare (no. 18594-210412). For statistical analysis, R software version 4.0.2 was used. The Student's t-test, Chi-square test, and binomial logistic regression analysis were used, with the objective variable being "I think my body is fat and p-values < 0.05 considered as significant.

Results: The proportion of Japanese adolescents who perceived themselves to be overweight was significantly higher in girls (60.2%) than in boys (27.8%) (p < 0.001). Five items were selected for girls, including "I dislike my body" (p < 0.001). However, eating habits had no effect on their sense of being overweight. For boys, five items were selected, including "on a diet" (p = 0.002) and "breakfast intake" (p = 0.047).

Conclusion: This study suggests that while adolescent girls in the Niigata Prefecture have a high rate of distorted body-shape perception it was unrelated to their eating behavior, while adolescent boys' beliefs that they were obese was related to their eating behavior. Therefore, we infer that measures for adolescents who misjudge their body shape vary by gender.

Keyword: Adolescents, Perception, Underweight, Thin, Breakfast

PAB(T3)-21

Lifestyle, physique and bone mass of female college students who have a habit of skipping food

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Objectives: A previous study of bone mass and lifestyle of female university students, it was reported that those who had a habit of skipping meals in junior high school tended to have low bone mass. Therefore, this study additionally examined dietary habits, physique, and bone mass of female university students who currently have a habit of skipping meals.

Methods: Physique, body composition, and bone mass (ultrasound method) were measured in 211 female university students (average age 19.6 ± 0.5 years). A questionnaire survey on past and present lifestyles, awareness of changes in dietary intake, and a food intake frequency survey on nutritional intake status were completed by the subjects.

Results: Findings showed 42 subjects (19.9%) did not eat three meals a day more than three times a week (meal-skipping group). Comparison of the meal-skipping versus the non-meal-skipping subjects demonstrated that there was a significant frequency of skipping meals observed in elementary school (19.0%, p <0.01), junior high school (28.6%, p <0.01), and high school (45.2%, p <0.001). Furthermore, there were 5 subjects found to have skipped meals starting from elementary school until the present. Comparisons of physique, body composition, and bone mass found no differences between the meal-skipping and non-meal-skipping groups. In terms of nutritional intake, vitamin D was low (p <0.01), while the percentage of fat energy was high (p <0.05) in the meal-skipping group. Nutritional intake classification by food group showed that the meal-skipping group had low intakes of algae, fishes and shellfishes (p <0.01, p <0.001), while there were high intakes of milk, confectioneries, and beverages (each p <0.05). When asked about any dietary issues, some of the respondents did indicate an awareness of a problem with their own diet (73.8%, p<0.01) in the meal-skipping group.

Conclusión: There was no difference in the physique, body composition and bone mass associated with the current eating habits of female university students. These results suggest that the reason why the vitamin D intake was low, and the percentage of fat energy was high in the meal-skipping group may be related to the intake of fishes and shellfishes, confectioneries, and beverages.

Keyword: bone mass, lifestyle, nutrition intake, female university student, skipping meals

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-22
Adoptin of healthy baby toolkit in feeding children in fragile environments of Uganda

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Background and objectives: A major constraint to achieving nutrition outcomes in programs that target households with young children and/or women of reproductive age is inadequate use of OFSP and other locally available nutritious diets for household level consumption. The Development and Delivery of Bio-fortified Crops at Scale (DDBIO) project, implemented by International Potato Centre (CIP) and partners, scaled out the use of an innovative feeding toolkit, Healthy Baby Toolkit/HBT, to improve child diets to enhance outcomes beyond the broader nutrition promotion activities among caregivers of children under 5yr attending community-based monthly nutrition trainings (healthy living clubs). The objectives of this study are to evaluate the early adoption of the HBT in feeding children (6-23 mos) of caregivers attending the healthy living clubs and assess the association between participation in nutrition trainings and the adoption of the HBT.

Method: In this community-based cross-sectional survey in Eastern and Northern Uganda, a total of 233 participants were randomly sampled from caregivers attending monthly nutrition trainings organised by CIP in Uganda for a period of 8 trainings.

Results: Findings indicate a high understanding of the important concepts in proper feeding of children 6-23 mos. Caregivers utilized the HBT supplied to them to feed their children with nutritious and diverse foods including OFSP enriched porridge. In addition, they were willing to buy the HBTs at 1 USD in case the ones supplied to them got lost or old. There was a significant positive association between caregiver nutrition knowledge and willingness to pay for the HBTs.

Conclusion: The adoption and willingness to pay for the HBT implies that the technology can be scaled out to entrepreneurs if the relevant user information about the HBT and relevant nutritional information accompany the HBT.

Recommendation: The study recommends scaling up of the HBT technology by government and development partners to communities and recommends nutritional trainings to be prioritized in the communities through focused training of the VHTs.

Keyword: Orange-fleshed sweetpotato, nutritious diets, adoption, child feeding, community-based

Conflict of Interest Disclosure: No conflict of interest.

PAB(T3)-23
Development and validation of a prediction model for identifying the risk of inadequate protein intake in community-dwelling older adults

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Objective: Adequate protein intake is important to prevent frailty in older adults, but several older adults do not meet the required intake levels. Raising awareness of inadequate protein intake could lead to behavioral changes. However, typical dietary assessment methods may be burdensome for older adults, and few easy tools to identify inadequate protein intake are available. Therefore, we aimed to develop and validate a prediction model for identifying the risk of inadequate protein intake in Japanese community-dwelling older adults using a simple question on frequency of the intake of specific foods.

Methods: We used data of 2,174 older adults from the 2013 National Health and Nutrition Survey to develop the prediction model and data of 1,949 older adults of the 2017 National Health and Nutrition Survey for external validation. Protein intake was assessed from 1-day dietary records using a semi-weighted method. We used multivariable logistic regression with stepwise backward elimination to identify predictive variables for inadequate protein intake (<1.2 g/kg-bodyweight/day). Candidate variables were sex, age, body weight, food intake frequency (rice, bread, noodles, meats, fish, eggs, soybeans, green/yellow vegetables, and other vegetables) and meal frequency. Discrimination and calibration were assessed by area under the receiver operating characteristics curve (AUC) and the Hosmer–Lemeshow test, respectively.

Results: In the development and validation groups, 40.3% and 39.8% of older adults had a protein intake <1.2 g/kg-bodyweight/day, respectively. The developed model for predicting inadequate protein intake included sex, age, body weight, intake frequency of specific foods (rice, meats, fish, eggs, and soybeans), and meal frequency. In the development group, the AUC of the model was 0.73. The P-value for the Hosmer–Lemeshow test in the model was more than 0.05. For external validity, the AUC was 0.72 in the validation group.

Conclusions: Our results showed that the developed model could identify for inadequate protein intake in Japanese community-dwelling older adults. This prediction model comprising nine items could easily and quickly identify older adults at high risk of inadequate protein intake and is expected to be widely used in public health settings.

Keyword: protein, prediction model, older adults

PAB(T3)-24

Assessment of functional food *Dioscorea japónica* paste as a thickened liquid for elderly with dysphagia

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Background and objectives: Reduced swallowing function leads to malnutrition and deterioration of the quality of life in the elderly. In an aging society, the novel concept of dysphagia diet is essential in order to prevent diseases and maintain nutrition intake. Previously, we report that the inhibition of proinflammatory lipid mediator synthesis by *Dioscorea japonica (D. japónica)*, a wild yam, is effective in preventing chronic inflammation. Additionally, the paste of *D. japónica* has conformable physical properties, and is rheologically confirmed to be useful thickened liquid for dysphagia patients. The present study focused on the unique physical properties of *D. japonica* paste, and evaluated its stability and usefulness as a thickened liquid in a condition close to cooking.

Method: Freeze-dried *D. japonica* powder were used to prepare the paste as a thickened liquid and xanthan gum, and commercially available thickened liquids were used for comparison. Viscosities of the thickened liquids were measured using a cone and plate viscometer under the following setting: temperature of 20°C and shear rate of 50^{s-1}. Changes in viscosity of the thickened liquids were measured under various conditions of temperature, pH, NaCl addition and α-amylase addition.

Result: The viscosity of *D. japonica* paste was stable in NaCl addition, and was similar as that of the other thickened liquids in α-amylase addition. The viscosity of *D. japonica* paste was relatively stable on change in pH, but it was slightly unstable on change in temperature. *D. japonica* showed high versatility because the viscosity of *D. japonica* paste could be easily adjusted by modifying its blending amount and temperature.

Conclusion: The present study demonstrated that *D. japonica* paste had an excellent suitability and the usefulness as a thickened liquid compared with commercial thickened liquids. Therefore *D. japonica* paste will be a novel type of thickened liquid with adequate food functionality for the prevention of proinflammatory lipid mediators-related diseases.

Keyword: Dysphagia diet, Thickened liquids, Viscosity, Dioscorea japonica, Functional food

PAB(T3)-25

Relationship between living arrangements and nutritional intake of community-dwelling older people in the 2019 Tarumizu study

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Background and objectives: Extending healthy life expectancy is important for the older, and this requires that they have proper nutritional intake. However, the dietary habits of the older are predicted to be influenced by their living arrangements. Therefore, the purpose of this study was to clarify the relationship between living arrangements and nutritional intake among community-dwelling older people.

Methods: The Tarumizu study was initiated in 2017 as a community-based health assessment survey jointly conducted by Tarumizu City and Kagoshima University. Energy and nutrient intakes were assessed through a dietary survey using a simplified Brief-type self-administered Dietary History Questionnaire (BDHQ). In this study, we compared those who lived alone and those who did not live alone, i.e., those who lived with their families, each gender, among those aged 65 years and older living in Tarumizu City, Kagoshima Prefecture, who participated in the study in 2019.

Results: The participants consisted of 47 men living alone and 208 not living alone and 140 women living alone and 295 not living alone. Energy intake did not differ by household for either sex, with men living alone: 2016±621 kcal, not living alone: 2174±602 kcal, and women living alone: 1774±555 kcal, not living alone: 1816±486 kcal. Energy-producing nutrient intake did not differ depending on the household for protein and fat intake, while carbohydrate intake tended to be higher among men who did not live alone (271.1±84.6 g) than those who lived alone (247.8±79.3 g) (p=0.08). In terms of vitamin and mineral intake, potassium and vitamin C intake was higher in men who did not live alone than in those who did live alone. For women, retinol, vitamin B_2, and vitamin B_{12} intake was higher among those who "lived alone" than among those who "did not live alone.

Conclusions: In conclusion, we found that nutritional intake varied by living arrangement. In particular, differences by gender were observed, with better nutritional intake for men living with family and women in a single household.

Keyword: Tarumizu-study, community-dwelling older people, nutritional intake, living arrangement

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-26
Effect of fetal carbohydrate restriction on intestinal flora in mice

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Background and objectives: In recent years, many young women in Japan have a desire to lose weight. There is concern that undernutrition in women of childbearing age increases the rate of premature birth and low birth weight babies, and that such children will have an increased risk of developing obesity and metabolic syndrome in the future. It has been reported that the intestinal microbiota regulates the host energy metabolism. Furthermore, it has also been reported that the maternal intestinal flora influences the formation of that of the offspring. In a previous study, we found that total nutritional restriction in late pregnancy in mice exacerbates obesity, glucose and lipid metabolism, while carbohydrate restriction ameliorates obesity and glucose metabolism in the offspring. In this study, we investigated the changes in the intestinal flora caused by carbohydrate restriction during the fetal period.

Methods: Eight-week-old male and female C57BL/6J mice were mated. In late pregnancy, female mice were fed with a standard diet (control group) or a carbohydrate-restricted diet (carbohydrate-restricted group) and gave birth to offspring. After giving birth, all groups of dams were given a standard diet. Feces were collected from the offspring immediately after weaning, and intestinal flora were analyzed by 16S rRNA sequencing.

Results: Principal coordinate analysis revealed that the intestinal flora of the control and carbohydrate-restricted groups formed different clusters. Analysis of intestinal flora composition at the genus level showed an increase in *Prevotella Bacteroides* (*PB*) ratio, reported to be associated with weight loss, in the carbohydrate-restricted group. In addition, the carbohydrate-restricted group induced changes in intestinal flora, including a decrease in *Clostridium* spp. and *Escherichia* spp. and an increase in *Anaerotruncus* spp.

Conclusion: Prenatal carbohydrate restriction caused the changes in the intestinal flora, such as an increase in *PB* ratio, which may contribute to the improvement of obesity and glucose metabolism in high-fat diet-fed mice.

Keyword: carbohydrate restriction during pregnancy, intestinal flora, obesity, metabolic syndrome

PAB(T3)-27
Adjusting prenatal iron supplementation to women's needs in early pregnancy to improve maternal iron status in late pregnancy

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Background and objective: Inadequate iron status (deficit and excess) during pregnancy has been associated with problems in maternal–fetal health. The present analyses aimed to assess whether different doses of prenatal iron supplements, adapted to women's needs in early pregnancy, help to improve maternal iron status in late pregnancy.

Methods: The ECLIPSES study involved 791 women recruited before gestational week 12. Participants were randomized into two groups according to their hemoglobin (Hb) levels: group 1 when Hb=110-130 g/L, and group 2 when Hb>130 g/L. Women received 20 vs. 40 mg/day or 40 vs. 80 mg/day of iron, respectively. Iron deficiency (ID) in the first and third trimester was defined as serum ferritin (SF)<15 µg/mL, anemia as Hb<110 g/L, and iron deficiency anemia (IDA) as SF<15 µg/mL and Hb<110 g/L. Extensive maternal information was recorded and considered as potential confounders: clinical, biochemical, and genetic information, as well as sociodemographic and lifestyle characteristics.

Results: In women in group 1, taking 80 mg/day protected against ID in the overall sample. In addition, taking 80 mg/day increased Hb levels at the end of pregnancy in women with baseline ID, showing an additional benefit against anemia and IDA. In group 2 participants, taking 20 mg/day protected against hemoconcentration in those without baseline ID, while 40 mg/day improved final SF levels in women with baseline ID. Genetic alterations in the HFE gene may predispose to hemoconcentration.

Conclusions: Maternal iron supplementation should be adapted to both circulating and stored iron in early pregnancy. Other factors such as genetics should be considered in clinical practice in women with elevated Hb levels.

Keyword: Iron supplementation, Serum ferritin, Hemoglobin, Pregnancy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-28

Re-examination of hemoglobin cut-offs defining anemia in school-age children and adolescents aged 5-19y

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Background and objectives: Current WHO hemoglobin (Hb) thresholds for anemia (115 g/L for children 5–11y, 120 g/L for children 12–14y and non-pregnant women 15y and older, and 130 g/L for men 15y and older) are used to inform and evaluate public health programs but were not derived using data representing diverse geographies. Our objectives were to use multi-country data on children 5–19y to determine the appropriateness of pooling Hb thresholds across countries and compare the 5th percentile for Hb, adjusted for elevation and smoking, to current thresholds for anemia.

Methods: We analyzed data from 36,967 apparently healthy (no inflammation or malaria) children aged 5–19y without iron or vitamin A deficiencies from 15 countries collected between 2006–2019: Azerbaijan, Bangladesh, Colombia, Ecuador, Ghana, Georgia, Guatemala, Laos, Liberia, Malawi, Mexico, Nepal, Great Britain, the United States, and Vietnam. A minimum sample size of 100 per age-sex category was required for the calculation of percentiles. Linear quantile mixed models with country as random effect were used to examine the intra-cluster (country) correlation coefficient (ICC) at the 5th percentile. Univariate ranking and meta-analysis were used to generate pooled 5th percentile estimates for each age-sex category.

Results: An ICC of 6% indicated that 94% of the variance around the 5th percentile was due to participant-level heterogeneity. Pooled 5th percentile Hb estimates were: children 5–11y (9 countries: 114.5 g/L, 95% CI: 111.1–118.0), children 12–14y (10 countries: 118.5 g/L, 115.3–121.7), girls 12–14y (10 countries: 117.1 g/L, 113.5–120.7), boys 12–14y (7 countries: 121.5 g/L, 117.5–125.4), girls 15–19y (13 countries: 114.2 g/L, 110.2–118.2), and boys 15–19y (3 countries: 126.8 g/L, 109.5–144.1).

Conclusion: Among healthy children 5–19y from diverse countries, current WHO Hb thresholds for identifying anemia aligned with 5th percentiles in all groups except girls 15–19y, for whom a lower threshold may be considered. A comparative analysis with women 20–49y will inform whether a change in thresholds is warranted for girls 15–19y. Given limited data on boys 15–19y, information on this demographic from additional countries is needed.

Keyword: hemoglobin thresholds, anemia, school-age children, adolescents

PAB(T3)-29

Relationship between changes in body mass index and eating habits of children aged 1.5–3 years.

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Background and objectives: An early adiposity rebound (AR) is associated with an increased risk of childhood obesity. This study assessed maternal and childhood lifestyle and dietary factors for increase in the body mass index (BMI) of children aged 1.5–3 years.

Methods: All participants were born between February 2015 and February 2016. Questionnaires were collected during the children's routine check-up at 4 months, 1.5 years, and 3 years of age in City A, Fukuoka, Japan. A total of 354 children who had undergone all the check-ups and whose data at the three check-ups were available and linked were included into the study. To compare the children and mothers' lifestyles, eating habits, and the children's degree of obesity, the participants were divided into two groups: the increased BMI group (BMI+, n=100) and the decreased BMI group (BMI-, n=254).

Results: The BMI+ group had a lower BMI at 4 months and 1.5 years of age than the BMI- group, but had a higher BMI when aged 3 years. When their children were aged 3 years, mothers in the BMI+ group had a significantly higher weight and BMI. Moreover, many mothers had a low subjective economic status when their children were aged 1.5 years. The snack (e.g., chips) intake of the BMI+ group at 1.5 years of age was higher than that of the BMI- group. The odds ratio of the BMI+ group to the BMI- group was 2.262 (95% confidence intervals: 1.373–3.724) for frequency of milk and dairy intake for mothers of children aged 1.5 years, and 1.955 (1.092–3.501) for that of frequency of children's snack food intake. An overall analysis showed that the BMI- group had a significantly higher proportion of children at 1.5 years of age with a degree of obesity of +15 or higher than the BMI+ group. However, it was higher in the BMI+ group at 3 years of age.

Conclusions: Snack intake in children might be associated with early AR and the transition to childhood obesity in children with early AR initiation. Therefore, dietary guidance is important from early childhood.

Keyword: adiposity rebound, childhood obesity, child health check-up, eating habits, snack

PAB(T3)-30
Creating an Enabling Environment for Baby-Friendly Hospital Initiative: Two Country Case Study of Malawi and the Kyrgyz Republic

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Background and objectives: In 2018, WHO and UNICEF made major changes to the implementation guidance of the Baby-Friendly Hospital Initiative (BFHI) to facilitate the integration of the Ten Steps of successful breastfeeding into the standards of prenatal, maternity, early postpartum, and newborn care. Since the inception of BFHI in 1991, improved hospital practices resulting from its implementation proved to be effective in increasing rates of initiation and exclusive breastfeeding and in some countries, breastfeeding duration, too. To motivate hospitals to maintain the practices, they were granted a baby-friendly designation. With a paradigm shift away from external certification, public recognition, and dependence on in-service training, creating an enabling environment is required to institutionalize BFHI. The objective of this paper is to share country experiences with establishing an enabling environment for BFHI in Malawi and the Kyrgyz Republic.

Methods: We conducted a qualitative study of BFHI with in-depth interviews of 85 key informants of policy makers, stakeholders, managers and service providers from both countries. Using ATLAS.ti, we analyzed texts from interviews and documents using deductive codes informed by the research questions and inductive codes based on the data from each country.

Results: These countries reported they learned that an enabling environment for BFHI, including a strong policy environment, a cadre of well-trained trainers and managers, clear responsibilities for BFHI at all levels, an understanding of motivations at the individual and systems level to make incentives effective, and that quality improvement approaches can be employed to monitor and improve delivery of breastfeeding counseling and support. Pre-service training in breastfeeding support and counseling was not fully established.

Conclusions: Despite financial and human resource constraints, countries are deeply committed to BFHI. They have national and local policy guidance and implementation structures that support institutionalizing BFHI. They have trained national level trainers and managers. However, they continue to struggle to create a fully strong enabling environment and require some external support. The transition to full integration of BFHI into the standards of care requires a multi-sectoral approach to include health, education, and finance sectors at national and local levels.

Keyword: Baby-Friendly Hospital Initiative, Kyrgyz Republic, Malawi, pre-service breastfeeding training, breastfeeding policies and programs

PAB(T3)-31
Improving breastfeeding behaviours through traditional birth attendant support: A case study of Alive and Thrive, Nigeria

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Background: In Kaduna and Lagos, Nigeria, 21% of pregnant women access services at health facilities while 39% seek care from traditional birth attendants [TBA] as a more patient-centered and inexpensive option. [1,2] Rates of early initiation [EI] and exclusive breastfeeding [EBF] remain persistently low at 32.8% and 29% (NDHS, 2018), due largely to inadequate knowledge and lack of family support for breastfeeding. The preference for TBA services makes them crucial to the effort to improve breastfeeding behaviors. Therefore, Alive and Thrive [A&T], funded by the Bill and Melinda Gates Foundation, partnered with local health authorities (LGA) to increase knowledge and improve interpersonal communication [IPC] skills of TBAs in order to improve infant and young child feeding [IYCF] practices in Kaduna and Lagos.

Method: Local authorities selected 1,554 TBAs in 26 LGAs across Lagos and Kaduna to participate in A&T's capacity strengthening program. They received training and coaching on appropriate IYCF practices and IPC for effective counseling during antenatal care and home visits, as well as hands-on support for EI and EBF, emphasizing the benefits for mother and baby and supporting women in labor to breastfeed immediately upon delivery. A&T assessed progress via routine monitoring during supportive supervision visits and through health facility records of EBF and EI.

Results: Program monitoring data showed that 460,290 pregnant and lactating women received improved counselling during the program and that the rate of EI was higher than the national rate of 32.8%. In Lagos, of the 6,355 newborns delivered with the support of A&T trained TBAs, 6,110 (96%) were put to the breast within one hour of delivery while in Kaduna the result was 28,398 of 30,045 newborns (95%). TBA testimonials noted that they would promote EI with patients as it resulted in good outcomes for the baby and better outcomes for them as practitioners.

Conclusion: TBAs are essential change agents and frontline workers whose strengthened capacity can significantly impact breastfeeding behaviors in their communities.

Keyword: traditional birth attendants, infant and young child feeding practices, pregnant and lactating women, early initiation of breastfeeding

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-32

Exploring the alcohol intake in community-dwellin older adults living in Auckland, New Zealan

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Background and objectives: In a period of global ageing evidence suggests older adults are now drinking more than ever. There is limited evidence regarding types of alcohol consumed and adherence to alcohol consumption guidelines in older New Zealand adults. This study explored alcohol intake patterns in community-dwelling older adults (65-74 years) living in Auckland, New Zealand.

Methods: This study was a sub-study of the REACH (Researching Eating, Activity and Cognitive Health) study. Older adults aged 65 to 74 years living in Auckland completed demographic and dietary questionnaires, including questions specific to alcohol intake.

Results: Participants (n=371) included 64% females and were mainly of New Zealand European ethnicity (94%). Most (81%) consumed alcohol, 15% never drank and 4% used to drink alcohol. Most participants consumed alcohol within the New Zealand Ministry of Health daily (99%), weekly (96%) and per occasion (96%) guidelines, and 84% had two or more alcohol-free days per week. The most common types of alcoholic beverages consumed were beer (0.9±2.1 (mean±SD) standard drinks per week), red wine (1.7±3.1) and white wine (1.8±3.6). Males consumed more standard drinks per week (6.4±7.4) than females (4.3±5.6). For those who consumed alcohol, drinking occurrence was at least weekly. Men were more likely to consume beer (59% males; 7% females) and red wine (49% males; 31% females), while females were more likely to consume white wine at least weekly (45% females; 32% males). Multiple linear regression analysis found 'sex' (being male) and 'index of multiple deprivation score' (less deprived) were positively associated with maximum standard drinks per occasion. 'Age', 'education' and 'living situation' were not associated with maximum standard drinks per occasion in older adults.

Conclusions: Over 80% of older New Zealanders consumed alcohol, with men more likely to consume beer and red wine, and less likely to consume white wine. Most older consumers drank within the New Zealand Ministry of Health guidelines. Being male and having a lower level of deprivation were positively associated with maximum number of drinks consumed per occasion. Further research is needed in a more representative sample of older New Zealand adults to confirm these findings.

Keyword: elderly, drink, alcoholic beverage, beer, wine

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

PAB(T3)-33

Documentation and Evaluation of the Adequacy of Complementary Foods Used by Mothers/Caregivers in the Southeast Geo-political Zone, Nigeria

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Background and Objective: High prevalence of childhood malnutrition in Nigeria has been attributed to suboptimal infant and young child feeding (IYCF) practices; therefore, this study aims to document and evaluate the adequacy of complementary foods used by mothers/caregivers in Southeastern Nigeria.

Methods: A cross-sectional survey involving 1200 households was carried out in three States, in Southeast, Nigeria. Multistage sampling technique was used to select households with mothers/caregivers and children aged 6-24 months from each State. Ethical approval and informed consent were duly obtained. Focus group discussions and semi-structured questionnaire were used to elicited information on IYCF practices and recipes of complementary foods used by mothers/caregivers. These recipes were standardized, prepared, and chemically analyzed and in some cases calculated for their proximate, β-carotene, vitamins A and C, folate, minerals (calcium, iron, zinc and iodine) and anti-nutrients (phytate and tannin) composition using standard methods. Phytate: zinc molar ratio was used to determine the bioavailability of zinc. The nutrient composition the cereal paps, complementary foods and food supplements were presented as means ± SD per 100g samples, while the amount of nutrient supplied by the complementary foods as consumed were compared with standards recommended for complementary foods for infants 6-8 months, 9-11 months, and 12-24 months.

Results: Cereal paps were the most widely used complementary food but enriched/supplemented with home-processed single foods (soybean flour or unripe plantain flour) or various flour blends made from soybean, crayfish/dry prawn/dry fish, green plantain, groundnut, and sugar. Commercial/institutional complementary food made of soybean, ground nut and wheat was encountered. The supplements were high in protein (24.4 - 44.7%), fat (8.1-17.6%) and energy (1731-2219 KJ/414-531 Kcal/100g dry weight). Unripe plantain flour was the least in protein (6.8%), fat (1.2%) and energy (1412 KJ/357 Kcal/100g). The phytate: zinc molar ratios were high (>15). When these supplements were incorporated into cereal pap as consumed by the children, they were found to be adequate in energy, protein, and vitamin A but deficient in all the minerals analyzed.

Conclusion: Home-made complementary foods in their present condition cannot meet many of the mineral needs of IYC unless supplemented with fruits and vegetables powders.

Keyword: Complementary foods, supplements, Nutrient composition, Adequacy, Nigeria

Conflict of Interest Disclosure: The Authors declare that there is no conflict of interedt

Further Collaborators: None

PAB(T3)-34
Gestational weight gain and perinatal outcomes in Western Brazilian Amazon

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Background and objective: Maternal undernutrition and excess weight during gestation are highly prevalent in low- and middle-income countries and are associated with adverse obstetric outcomes and poor offspring health. However, GWG is a potentially modifiable exposure factor. Thus, the study objective was to investigate the association between gestational weight gain (GWG) and perinatal outcomes in Amazonian postpartum women.

Methods: Data of mother-child pairs (n=1305) participants in the Maternal and Child Health and Nutrition in Acre (MINA-Brazil) birth cohort study was used. The exposure of interest was GWG, which was classified as insufficient, adequate, or excessive according to the Institute of Medicine guidelines. Poisson and linear regression analyses were performed to evaluate the associations between GWG and birthweight (BW) z-scores, low birthweight (LBW), macrosomia, small for gestational age (SGA), large for gestational age (LGA), preterm birth, caesarean delivery, maternal hemoglobin, and gestational anaemia. The level of significance was set at P < 0.05.

Results: Inadequate GWG accounted for 64.7% of pregnancies, with similar rates (32%) of insufficient and excessive weight gain. Compared with adequate GWG, excessive GWG was associated with 0.41 higher mean new-born BW Z-score (95%CI 0.29, 0.53), increased risk of macrosomia (adjusted relative risk [RR]: 1.68; 95%CI 1.02, 2.76), LGA (RR: 2.16; 95%CI 1.56, 3.01), cesarean delivery (RR: 1.26; 95%CI 1.11, 1.43), and lower risk of LBW (RR: 0.44; 95%CI 0.27, 0.73) and SGA (RR: 0.38; 95%CI 0.21, 0.68). Women gaining insufficient GWG presented a mean new-born BW z-score 0.16 lower (95%CI -0.29, -0.04) than those who gained adequate weight.

Conclusions: In this population, the inadequacy of gestational weight remains an important health concern since most women ended their pregnancies with inadequate weight. Insufficient and excessive GWG were associated with adverse perinatal outcomes, highlighting the need for actions to promote adequate gestational weight gain in the Amazon population. Antenatal care visits should be maximized for monitoring weight gain, along with relevant counselling about healthy eating and physically activity to support appropriate GWG.

Keyword: Gestational weight gain, Institute of Medicine, Perinatal outcomes

Conflict of Interest Disclosure: Nothing to declare

Further Collaborators: The MINA-Brazil Study was supported by the São Paulo Research Foundation (FAPESP, grant number 2016/00270-6) and I received scholarships from the Coordination for the Improvement of Higher Education Personnel (CAPES, grant number 372666/2019-00).

PAB(T3)-35
A questionnaire survey on eating habits of Japanese infants and children

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Background and Objects: Although eating habits from infancy to childhood are thought to be essential for life-long health, little data have been provided to support the view. We conducted a questionnaire survey on diet and related everyday problems in Japanese infants and children.

Methods: We have constructed the large-scale database (n > 1300 pairs) on the gut microbiome, physical and mental condition, and cognitive development of children aged 0–4 years and their mothers through 103 children's parks and kindergartens in Japan. The questionnaire on the eating habits of children included the frequency of intake of 24 foods within a week, food preferences, health status, and the issues related to sleeping, bowel, and eating habits. Additionally, cognitive development was evaluated using the BRIEF-P scale. For statistical analysis, we used nonparametric methods.

Results: Children with no health problems (46%) consumed significantly more vegetables, mushrooms, fruits, beans, and eggs than those with health problems ($p < 0.05$). Particularly, children with a high incidence of cold (24%) and fever (13%) ate fewer vegetables and mushrooms than those with a low incidence ($p < 0.05$). Importantly, after 18 months of age, the dislike for vegetables more than doubled (38%) than the previous age (17%). “Making (42%)” and “feeding (23%)” were the most common issues relating to parenting stress. Many dietary problems were also observed, such as “the amount of food eaten is not constant (27%)” and “unbalanced diet (35%).” Finally, the children (3-4 years) at risks of cognitive development (10%) consumed fewer deeply colored vegetables than those at no risk ($Z = -2.28$, $p = 0.27$).

Conclusions: The intake of vegetables and fruits is related to the health maintenance and cognitive development of Japanese infants and children. However, since the number of infants disliking vegetables has remarkably increased from the end of infancy, effective strategies for motivating infants for consuming vegetables are required. This may also assist in reducing parenting stress.

Keyword: questionnaire survey, eating habits, Japanese, infants, children

PAB(T3)-36

Maternal dietary quality assessed by Nutrient-Rich Food Index 9.3 and attitude towards dietary habits in a Japanese single-center birth cohort

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Background and objectives: The maternal diet can potentially influence the life-course health of the child. Using the Nutrient-Rich Food Index 9.3 (NRF9.3), we previously assessed the overall dietary quality of pregnant women during mid-gestation in an urban area of Japan. The NRF9.3 score was inversely correlated with the Dietary Inflammatory Index score, which reflects the inflammatory capacity of the diet. Vegetables and fruits were the food groups chiefly associated with high dietary quality assessed by NRF9.3, consistent with the results of other studies that analyzed dietary patterns in food-based manner. This study investigated how the mother's attitude towards dietary habits affects NRF 9.3 score.

Methods: Data were derived from 108 participants in the Birth Cohort-Gene and ENvironment Interaction Study of Tokyo Medical and Dental University (BC-GENIST). Information on satisfaction with the current diet, perceived body-size image, supplement intake status, foods that are actively consumed or avoided, educational attainment, and economic status was collected via a self-administered lifestyle questionnaire. The level of satisfaction with the current diet was assessed using the following five categories: “very satisfied”, ”satisfied”, “neutral”, ”dissatisfied”, and “very dissatisfied”. The level of perceived body-size image was assessed as the following: “very lean”, ”underweight”, “normal”, ”overweight”, and “obese”. Descriptive statistics and linear test for trend or t-test were performed to compare NRF9.3 scores across categories of each variable.

Results: Higher NRF 9.3 scores were observed with higher levels of dietary satisfaction and leaner body image. These associations remained after adjustment for maternal age, pre-pregnancy body mass index, educational attainment, and economic status ($p = 0.032$ and 0.0046, respectively). Supplement intake status was not associated with NRF 9.3. The participants actively consuming vegetables had significantly higher NRF9.3 ($p = 0.014$).

Conclusions: There was a significant positive association between satisfaction with dietary life and NRF 9.3, suggesting that dietary satisfaction, as well as nutritional value, is important for improving overall dietary quality. It was also indicated that an awareness of active vegetable intake contributes to an increase in overall dietary quality.

Keyword: maternal dietary quality, Nutrient-Rich Food Index 9.3, Developmental Origin of Health and Disease, dietary satisfaction

Further Collaborators: Ayako Fudono (Tokyo Medical and Dental University), Iori Tarui (National Institutes of Biomedical Innovation, Health and Nutrition), Tomoko Aoyama (National Institutes of Biomedical Innovation, Health and Nutrition), Satoshi Yago (Tokyo Medical and Dental University), Motoko Okamitsu (Tokyo Medical and Dental University), Satoshi Sasaki (The University of Tokyo), Shuki Mizutani (Tokyo Medical and Dental University)

PAB(T3)-37

Effect of malted-rice amazake intake on defecation and nutritional status of hospitalized or institutionalized elderly

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Background and objectives: Approximately 20% of the late elderly are malnutrition, and one in nine persons over 80 years of age complains of constipation. In the elderly, constipation can easily lead to abdominal pain, vomiting, anorexia, inflammation, etc., thus highly likely to lead to malnutrition. Therefore, it is important to take remedial measures focusing on defecation and nutritional status. This study examined the effects of malted-rice amazake intake on defecation and the nutritional status of hospitalized elderly patients and institutionalized residents.

Methods: The subjects were 27 elderly (86.2±7.5 years old) who were hospitalized or admitted to a hospital or a nursing home. The schedule consisted of daily intake of malted-rice amazake for the first 6 weeks and no amazake intake for the second 6 weeks. Body composition, blood biochemical test, nutrient intake, defecation, and prescribed medications surveys were performed before the intervention (0w), after the intervention (6w), and after 6 weeks of intervention (12w).

Results: The BMI significantly increased after amazake intake. There was also an increasing trend in albumin from 3.3 ± 0.4 g/dL (0w) to 3.4 ± 0.5 g/dL (6w), while significant increases in lipid and vitamin D were observed for nutrient intake other than amazake. The subjects were divided into Constipated Group (CG: n=12) and Non-Constipated Group (NCG: n=15) according to 0w's score of CAS (Constipation Assessment Scale). The CG improved the constipation symptoms from 0w to 12w, showing an increasing trend in BMI. In the grouping by GNRI (Geriatric Nutritional Risk Index), there was a trend of increasing BMI from 0w to 12w in the no nutritional disability risk (GNRI>98) or mild nutritional disability risk (92<GNRI<98) group (n=6). There was no significant change in the severely malnourished risk (GNRI < 82) group (n=8).

Conclusions: Consumption of malted-rice amazake by hospitalized or institutionalized elderly for 6 weeks suggested the possibility of improving constipation symptoms and nutritional status. The effects of amazake consumption may differ depending on the subject's condition prior to the intervention.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Malted-rice amazake, Elderly, Malnutrition, Constipation, GNRI

from the São Paulo Research Foundation (FAPESP, grant number 2021/01688-2). The funders had no role in study design, data collection and interpretation.

PAB(T3)-38
Breastfeeding Practices and Head Circumference in the First Two Years of Life: a Systematic Review

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Background and objectives: After birth, the human skull and brain undergo intense connectivity and transformation. Such changes occur at a greater speed, mainly during the first years of life, and an accelerated head circumference (HC) increase reflects this process. Breastfeeding (BF) plays a pivotal role in early brain development owing to its nutritional composition and emotional mother-infant interaction and bonding, but its effects on HC remain uncertain. This systematic review aimed to gather observational studies that investigated the association between BF practices and HC in children up to two years of age in different populations.

Methods: A search protocol was developed beforehand and registered in the International Prospective Register of Systematic Reviews (ID 252891). The systematic review was conducted using the PubMed, Latin American and Caribbean Literature in Health Sciences (Lilacs), Web of Science and Scopus databases. We selected observational studies published in any language from January 01, 2010 to November 19, 2021, from different populations that investigated the association between BF practice and HC among healthy children <2 years old. Titles and abstracts were screened independently by two evaluators.

Results: From the 4229 articles identified, 24 were included in this review: 6 cross-sectional, 17 longitudinal, and 1 case-control. The definition of the variables for BF varied across studies; reporting its practice, and its frequency, duration, and offering route. Regarding HC, the authors analyzed the mean differences, abnormal values (z-score above + 2SD or below -2SD according to the World Health Organization, WHO, growth standards, 2007) and longitudinal growth parameters.

Conclusions: The findings of this review suggest that BF may have a positive relationship with HC at the beginning of life. Cross-sectional studies provide some support that exclusive BF may play a protective role against abnormal HC values in vulnerable contexts. However, when HC is considered as a continuous variable, the positive association with BF is not clear, regardless of the regional economy of the population under study. More robust evidence using BF standardized assessment and WHO growth standards (2007) and in low-income countries are required.

Keyword: head circumference, breastfeeding, formula feeding, child growth, child development

Further Collaborators: The MINA-Brazil Study was supported by the São Paulo Research Foundation (FAPESP, grant number 2016/00270-6). Isabel Giacomini received scholarships

PAB(T3)-39
Dietary intake of picky eaters associated with sensory profiles among college students

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Background and objectives: Picky eating (PE) affects eating behavior and unhealthy dietary intake among children and adults. Sensory sensitivity is associated with PE; however, it is not well-known whether sensory profiles are associated with PE in adulthood. The aim of this study was to examine the association between PE, sensory profile, and dietary intake among college students, who are in an important period of emerging adulthood.

Methods: This cross-sectional study used data from 112 Japanese undergraduates at a women's university in 2018. Self-administrated questionnaires were utilized to assess sociodemographic characteristics (age, BMI, household size, weekly frequencies of hobby activities and part-time jobs), self-rated PE, sensory profile, self-rated health, and frequency of balanced meals containing staple food, protein-rich dishes, and vegetable-rich dishes. Self-rated PE was assessed as three levels: always/often, sometimes, and rarely PEs. The 60-item "Adolescent/Adults Sensory Profile" was used to assess four quadrant scores: low registration, sensory seeking, sensory sensitivity, and sensory avoiding. Dietary quality was assessed based on food frequency questionnaires. The Kruskal-Wallis test and Pearson's chi-square test were used to compare the sociodemographic characteristics, self-rated health, and sensory profiles by perceived PE levels.

Results: Of 112 participants, 25 (22.5%), 45 (40.5%), and 41 (36.9%) participants were reported having always/often, sometimes, and rarely PE, respectively. Sociodemographic characteristics and self-rated health did not differ by PE levels. Higher scores of sensory sensitivity and sensory avoiding quadrants were observed among students having "always/often PE" (p=0.049 for sensory sensitivity; p=0.032 for sensory avoiding). Frequencies of balanced meals tended to be higher among participants in "rarely PE" (p=0.0055). Participants who reported "rarely PE" consumed more green and yellow vegetables, other vegetables, folate, and vitamin K, compared to those who reported "always/often PE" (96 vs. 51 g/day for green and yellow vegetables; 140 vs. 70 g/day for other vegetables; 291 vs. 214 µg/day for folate; 259 vs. 217 µg/day for vitamin K; p<0.05, respectively).

Conclusions: Sensory sensitivity and sensory avoiding quadrants were associated with PE, which leads to less vegetable consumption among college students. Strategies

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

considered in sensory profiles could be useful for reducing PE among college students.

Keyword: Picky eating, Sensory profile, College students

PAB(T3)-40
Food choice patterns of Japanese college female soccer players and effects on hepatic dysfunction markers

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Background and objectives: The daily dietary intake of athletes can affect their health, performance, and recovery from fatigue. Since only a limited of athletes receive individualized nutritional support, it is important to obtain information on the characteristics of the diet and problem. It leads to the ability to provide group guidance divided according to dietary characteristics may be possible even in situations where individual guidance is difficult. The purpose of this study was to investigate the characteristics of food choice patterns in female soccer players and to determine the associated effects on blood properties.

Methods: We measured the dietary intake, body composition, and blood parameters of 26 participants aged 18–22 years belonging to the Japanese women's university soccer team. Food intake was assessed using a validated food frequency questionnaire. The nutrition data were used to calculate the energy intake based on "Six Basic Food Groups" in Japan. The cluster analysis was performed using the percentage of energy intake of each food? group relative to the total. The results were compared between the clusters.

Results: Eleven participants were assigned to Cluster 1 and 15 participants, to Cluster 2. Cluster 1 had a significantly high intake of food groups that were rich in protein than Cluster 2. Cluster 2 had a significantly higher intake of food groups that were rich in carbohydrates and in fat than Cluster 1. There were no significant differences in the height, weight, BMI, and body fat percentage between the groups. Lean body mass and skeletal muscle mass were significantly higher in Cluster 2 than in Cluster 1. LDL-cholesterol ($p<0.05$), γ-GT ($p<0.01$), and ALT ($p<0.05$) blood levels were significantly higher in Cluster 1 than in Cluster 2, and abnormal values were found in 63% of Cluster 1, but they were all within the normal range in Cluster 2.

Conclusions: Food choice patterns of female soccer players could be categorized into two major groups according to the intake of carbohydrate and fat- and protein-rich foods; this may have an effect on the hepatic dysfunction markers. It may be possible to provide effective guidance to athletes in the group setting by classifying the characteristics of food selection.

Keyword: Quality of diet, Dietary patterns, Athlete, liver injury, Clustering

PAB(T3)-41
Adult Mortality in Rural Bangladesh: A Retrospective Cohort Analysis of 80,000 Mothers and Fathers

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Background and objectives: Little is known about the epidemiology and nutritional influences of adult mortality in rural South Asia. We estimated age-sex rates and causes of adult death in a multidecadal cohort of parents of reproductive aged women in rural Bangladesh.

Methods: We collected data on parents from 43,859 women ≤48 yr of age recruited into an antenatal micronutrient supplementation trial (2008-12), inquiring about their age, major illnesses, body type and vital status and, if deceased, age, year, antecedent morbidity and their understood causes of death. If unknown, age-at-death was imputed by applying coefficients associated with predictive socio-economic characteristics obtained from daughter respondents who did report parental age at death. We derived Kaplan-Meier parental survival curves, proportionate mortality by cause and risk ratios (RR) of death by reported parental phenotype (chronically thin, overweight or neither).

Results: Vital data were missing for 6583 (15%) fathers and 3533 (8%) mothers. Among remaining 37,273 fathers 30,360 were [median (IQR)] 55 (50-62) years of age and 6,913 (18.5%) had died at a median (IQR) age of 59 (51-65). Among remaining 40,326 mothers, 94% were 47 (42-52) years of age and 2,418 (6%) had died by a median (IQR) age of 47 (40-55). Daughters reported ~30% and ~18.5% of all fathers and mothers being thin for a long time and overweight, respectively. Compared to a normal body type, RRs for death were 1.24 and 1.44 for chronically thin, and 1.79 and 1.52 for overweight, fathers and mothers, respectively (all lower 95% CLs>1.15). Among fathers and mothers, chronic thinness (beyond the last year of life) posed higher risk of death from TB (RR=2.60, 4.12) and cancer (RR=1.8, 2.1). Reported overweight was associated with higher risks of death from heart attack/stroke (RR=2.60, 2.30) and sudden death unrelated to injury (RR=2.25, 1.51), with all lower 95% CL≥1.25.

Conclusions: In this middle-aged cohort of rural Bangladeshi men and women, among whom 18% and 6%, were deceased, chronic thinness and being overweight versus being neither were associated with ~1 ¼ to 2-fold higher risks of death, especially related to TB and cancer, and heart attack, stroke or sudden death, respectively.

Keyword: Adult mortality, Thinness, Overweight, Chronic disease, Bangladesh

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-42
The amount of iron eluted from iron balls in aqueous solutions

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Background and objectives: Anemia is a serious public health issue worldwide, and iron deficiency anemia is the most common type of anemia. Several studies have reported that blood hemoglobin levels increase when eating food cooked in an iron pot. However, iron pots are typically susceptible to rust and difficult to maintain. Japanese Nambu ironware is characterized by its resistance to rust. Various cooking utensils are made from Nambu iron, one of which are iron balls for cook. The aim of the current study was to ascertain the amount of iron eluted from Nambu iron balls in various aqueous solutions.

Methods: An aqueous solution (distilled water, a 1% salt solution, a 1% vinegar solution, a 10% vinegar solution, or a 10% tomato puree solution) was added to a glass pot and heated. Once the temperature of the liquid was confirmed to have reached 85°C, an iron ball was placed in the pot and heated for 5, 10, or 15 min. The iron ball was removed, and then distilled water in the same amount that had evaporated was added. This aqueous solution served as the sample solution. Iron was measured using 1,10-phenanthroline absorption spectrometry. The total acidity of the aqueous solution before heating was determined.

Results: The amount of iron eluted was greatest in a 10% vinegar solution at all heating times and was significantly greater than the amount of iron eluted in other aqueous solutions (p<0.01). A large amount of iron was eluted in a 10% tomato puree solution, followed by a 1% vinegar solution. The heating time and the amount of iron eluted were correlated for all of the aqueous solutions except distilled water (p<0.01). The total acidity and the amount of iron eluted were correlated for the 1% vinegar solution, the 10% vinegar solution, and the 10% tomato puree solution (p<0.01).

Conclusions: The current results revealed that the amount of iron eluted from an iron ball increased as a highly acidic aqueous solution was heated for longer. These findings suggest that use of iron balls to cook high acidic dishes may increase iron intake to a certain extent.

Keyword: Iron, Nambu Ironware, Total Acidity, Vinegar

PAB(T3)-43
Diet quality, drivers of food choices and self-efficacy among 15-19 years old adolescent girls and boys from low-income households in Dhaka city of Bangladesh: a cross-sectional survey

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Background and objectives: Adolescents' diets in low- and middle-income countries (LMICs) are shifting towards unhealthy energy-dense and nutrient-poor foods; particularly for adolescents living in urban areas. In LMICs, including Bangladesh, little is known about behavioural determinants related to diet quality, particularly food choice motives (FCM) and self-efficacy of healthy eating (individuals' belief in their ability to engage in healthy eating). This study aimed to evaluate which behavioural determinants are associated with diet quality among adolescents from low-income families in Dhaka city, Bangladesh.

Methods: A cross-sectional survey was conducted during October 2020 among adolescents aged 15-19 years old (n=299, 48% girls) selected from low-income households of urban and peri-urban parts in Dhaka metropolitan areas. The dietary diversity (DD) was assessed with the Minimum Dietary Diversity for Women score and adherence to the global diet recommendations was assessed with Global Dietary Recommendations (GDR) score, GDR-Healthy for 'healthy' foods and GDR-Limit for 'unhealthy' foods consumption. General linear modelling was performed to explore associations between diet quality and behavioural determinants (separately for DD, GDR-Healthy and GDR-Limit scores).

Results: The mean diversity score was 4.9 (SD=1.6) out of 10, and 60% of adolescents achieved minimum dietary diversity cut-off of consuming more than 5 food groups. The average GDR-Healthy score was 2.7 (SD=1.5) out of 9 food groups, and the GDR-Limit score was 1.6 (SD=1.5) out of 8 food groups. The most important FCM was safety, followed by healthiness of the food, taste, price, convenience and local or seasonal. The mean score of self-efficacy of healthy eating was 3.5 (SD=0.8) out of 5. Adolescents who had high self-efficacy scores, who valued FCM 'local or seasonal' more and 'price' less, had a better dietary diversity and higher intake of both healthy and unhealthy foods. These associations varied substantially by gender.

Conclusions: This study showed the relations between motivations, self-efficacy and diet quality of adolescents in urban Bangladesh. Interventions addressing self-efficacy and motivations related to food affordability and food being local or seasonal could contribute to increasing consumption of diverse and healthy foods, especially in combination with interventions in the food environment to increase availability of healthy options.

Keyword: diet quality, dietary diversity, food choice motives, self-efficacy, adolescent

Conflict of Interest Disclosure: No

Further Collaborators: Not Applicable

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-44
Unhealthy commercial food and beverage consumption among children 12-35.9 months of age in Guédiawaye Department, Senegal

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Background and objectives: A nutritious diet is important for young child development and can inform healthy lifelong dietary preferences. High consumption of unhealthy commercial foods and beverages (UCFB) - which are energy-dense and nutrient-poor - is therefore cause for concern. Growing evidence from Africa indicates UCFB consumption among young children is prevalent, but little is known about the degree or factors associated with such consumption patterns. This study aimed to assess UCFB consumption among children 12-35.9 months in peri-urban Dakar, Senegal and explored associations with socio-demographic characteristics.

Methods: A cross-sectional survey was conducted in November-December 2021 among a representative sample of 726 primary caregivers of children aged 12-35.9-months in Guédiawaye Department. A UCFB consumption score (min-max=0-24) was derived from a seven-day food frequency questionnaire including eight UCFB categories (biscuits/cookies; chips/puffs; crackers/salty popcorn; cake/donuts; candy/sweets/lollipops/chocolate; soft drinks; sweet milk/chocolate drinks (excluding breastmilk substitutes); and juice/fruit-flavored drinks) and four consumption levels (0=0 days; 1=1-3 days; 2=4-6 days; and 3=7 days).

Results: The mean number of the eight UCFB categories consumed at least once in the previous week was 4.0 (standard deviation=1.5; min-max=0-8). The most reported categories were biscuits/cookies and chips/puffs (83.9% and 82.0% of children respectively). Mean±SD UCFB consumption score was 6.4±3.3 (min-max=0-21). In an adjusted multivariate model, being an older child (24.0-35.9 months) and household food insecurity in the previous month were positively and significantly ($p<0.05$) associated with UCFB score. The most common reasons caregivers cited for feeding UCFB to their young child centered around palatability and child preference: given as a treat/gift (46.6%); child asked for it (40.2%); child likes it (31.3%); someone else was eating it so gave to child/child asked for it (28.9%); to calm child (28.5%). Caregivers rarely cited price/affordability (0.5%), accessibility (1.8%), or health/nutrition reasons (1.1%).

Conclusions: While not specifically made for young children, UCFB are commonly consumed among young children in Guédiawaye Department. Measuring and addressing UCFB consumption - and promoting nutritious, desirable, and palatable alternatives where this consumption is high - should be a program and policy priority to protect young child health and nutrition.

Keyword: dietary assessment, infant and young child feeding, unhealthy commercial foods, nutrition, Senegal

PAB(T3)-45
Physical Activity and Body Mass Index in Relation to Semen Quality

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Background and objectives: Infertility is a global social issue, and reproductive health is a priority in global health. In the context of increasing rates of overweight and obesity in young adult men, and the increasing numbers of men seeking help for fertility problems, it is important to understand whether physical activity (PA) could help with the management of reproductive health problems. This work aimed to study the relationship between physical activity (PA) and semen quality.

Methods: A cross-sectional study was carried out among 207 men aged 20–55. Physical activity was evaluated by the International Physical Activity Questionnaire. Semen parameters were assessed via computer-aided semen analysis (CASA). Body mass index (BMI) was calculated as the ratio of body weight and squared height, and evaluated according to the WHO cut-off points.

Results: In the association between PA and, vigorous PA in men with normal BMI resulted in both positive and negative effects that were weaker than those in men with high BMI. Among men with low BMI, moderate PA was weakly but positively associated with semen quality.

Conclusions: There is emerging evidence that PA intervention may be as effective as other commonly used clinical intervention strategies for improving reproductive health outcomes. Our preliminary findings suggest that PA may be an affordable and feasible alternative or complementary therapy to fertility treatments. However, our findings need to be confirmed by further prospective observational and clinical studies

Project financially supported by Minister of Education and Science in the range of the program entitled "Regional Initiative of Excellence" for the years 2019-2022, Project No. 010/RID/2018/19, amount of funding 12.000.000 PLN

Keyword: Physical activity, Fertility, BMI, Lifestyle factors

PAB(T3)-46

Characteristics of dietary practices, eating behaviors, and health awareness in Japanese middle-aged adults with no history of lifestyle diseases

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Background and objectives: The percentage of adults who develop lifestyle diseases increases sharply at 40 to 59 years of age. This suggests that examining the eating behaviors and health awareness of adults in this age group who have no history of lifestyle diseases may provide a clue to effective primary prevention. We therefore aimed to identify the characteristics of dietary practices, eating behaviors, and health awareness in adults of this age with no history of lifestyle diseases that are linked strongly to diet.

Methods: The subjects were 577 respondents to the 2016 Hyogo Diet Survey, aged 40 to 59 years, in Japan. The chi-square test was used to compare six dietary practices for lifestyle disease prevention and improvement (control energy intake, restrict salt intake, control fat intake, control sugar intake, eat a lot of vegetables, and eat fruits), as well as eating behaviors (eating breakfast regularly, having a well-balanced meal at least twice daily) and health awareness (use of nutrition facts labels, regular exercise, healthy weight maintenance), between subjects with and without a history of lifestyle diseases. A binomial logistic regression analysis was then performed, adjusting for sex, age, family composition, and BMI.

Results: The analysis showed significantly higher odds ratios for "control energy intake" at 1.64 (95% confidence interval: 1.12–2.41) and "control fat intake" at 1.53 (1.04–2.25) among the six dietary practices for lifestyle disease prevention and improvement in subjects with no history of lifestyle diseases. In terms of health awareness, significantly higher odds ratios were observed for "use of nutrition facts labels" at 1.53 (1.04–2.24) and "regular exercise" at 1.48 (1.03–2.15) in subjects with no history of lifestyle diseases.

Conclusions: Middle-aged adults with no history of lifestyle diseases were characterized by dietary practices such as controlling energy and fat, as well as having enhanced health awareness, including using nutrition facts labels and engaging in exercise.

Keyword: middle age, history of lifestyle diseases, lifestyle disease prevention, eating behavior, health awareness

PAB(T3)-47

In vitro estimates of the impact of whole grain and pulses addition on the iron absorption from complementary food

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Background: Iron deficiency is highly prevalent in preschool children. Fortified complementary food based on refined flour has been reported to provide bioavailable iron and to be efficient in reducing the risk of iron deficiency anemia. The partial replacement of refined flour and dairy proteins by whole grain and pulse flours in food may improve the metabolic response. However, both sources contain inhibitors, which may impair iron absorption.

The objective was to assess the iron bioavailability from complementary cereals, using the *in vitro* simulated digestion coupled with the Caco-2 cell model, and test recipes containing 16% whole grain (Wg) and 16 % Wg plus 19% legumes i.e., red lentils (WgRL), yellow lentils (WgYL), yellow pea (WgYP) chickpea (WgCH) compared to a recipe based on refined flour (RF). The evaluation was done 1) without added iron, and with and without ascorbic acid (AA), and 2) with added iron (8,5 mg/ 100g) and AA (molar ratio AA:Fe of 2:1).

Results: The addition of AA in recipes without added iron significantly increased the iron uptake of the intrinsic iron from all recipes in a range of 2,1 to 3,8-fold (p<0,002). The highest and lowest iron uptakes were observed in the WgCH and the WgYL recipes, respectively. The addition of iron and AA increased the *in vitro* absorption from all the recipes by 4 to 24-fold (p< 0,0003, and p<0,003 for WgCH). When compared to RF, the iron uptake from Wg was slightly lower, the addition of WgYL, and WgRL tended to increase the iron absorption, while WgYP and WgCH decreased it. Nevertheless, none of these results were statistically different except for WgCH (p<0.03). When comparing the iron absorption from the mixed recipes to that from Wg, the same trends were observed, and did not reach statistical significance.

Conclusion: Combined iron and AA fortification of all tested complementary cereals significantly increased their *in vitro* iron bioavailability. The addition of Wg and, Wg plus legumes was found to have limited impact on iron uptake when added with AA, except for the recipe with chickpea. This effect could be mitigated by decreasing addition levels in the formulation.

Keyword: iron, in vitro, absorption, complementary food

Conflict of Interest Disclosure: M. Sabatier, A. Rytz, C. Tudorica, Y. Shahkhalili-Dulloo, and K. Macé are employees of Société des Produits Nestlé S.A., Switzerland.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-48
Dietary habits and metabolic syndrome among Japanese employees

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Background and objectives: According to the 2019 National Health and Nutrition Survey, the prevalence of metabolic syndrome (MetS) and pre-MetS in Japan is 17.8% and 14.1%, respectively, and has been increasing in recent years. Therefore, this study aimed to investigate the relationship between food intake frequency and the development of MetS in Japanese employees. In addition, we aimed to examine differences in this association by age and sex.

Methods: The participants of this study were 12,542 employees at the University of Tokyo (6,402 men and 6,140 women) who underwent annual health check-ups in 2017. A self-administered questionnaire survey was conducted on lifestyle, dietary habits, and food intake frequency of the 13 food groups. Using data measured during physical and blood examinations, the participants were divided into two groups (MetS or non-MetS) according to abdominal obesity and other components of MetS risks such as hypertension, dyslipidemia, and diabetes mellitus.

Results: The prevalence of MetS was 13.8% for males and 2.6% for females. Among the participants with MetS, 8.9% of males and 2.0% of females were younger than 40 years of age, indicating that males are more likely to develop MetS at a younger age.

Among men, the odds ratios (ORs) for MetS among those who did not eat breakfast compared with those who did was 1.43 (95% confidence interval [CI]: 1.16–1.75), and the ORs for MetS among those who ate out three or more times a week compared with those who ate out less than once a week was 1.35 (95% CI: 1.01–1.83). In addition, for men, the ORs increased with increasing frequency of rice (at breakfast), eggs, and sweetened beverages, while the ORs decreased with increasing frequency of beans, milk, and sweets. For women, the trend was similar to men for added-sugar beverages and sweets.

Conclusions: Our study showed that the higher consumption of milk and legumes works to prevent MetS, while the higher consumption of rice (at breakfast), eggs, sweetened beverages, and salty snacks works to develop MetS. Particularly in men, prevention from a young age should include eating breakfast and eating out less often.

Keyword: metabolic syndrome, dietary habits, food intake, sex differences, cross-sectional study

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T3)-49
Associations between stress biomarkers and diet among Finnish preschoolers

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Background and objectives: Stress has been shown to associate with adverse health behaviors – also with higher consumption of highly palatable foods high in sugar, fat and/or salt. We examined the association between stress related biomarkers (salivary cortisol and alpha-amylase) and selected dietary variables among 3–6-year-old children.

Methods: We used a sub-sample (n=268) of children from cross-sectional data collected 2015–2016 in the DAGIS study in Finland. On one weekend day, the parents collected five saliva samples from the participating child. On the same day they kept of a food record of the child's food consumption. The following dietary variables were selected for analysis: sugary everyday foods (g/MJ), sugary treats (g/MJ), sugary beverages (g/MJ), all sugary foods (sum of the 3 previous categories (g/MJ), vegetables (g/d), fruits and berries (g/d), fat (g/MJ), added sugar (g/MJ), and energy (MJ). sCort concentrations were assayed using an enzyme immunoassay and sAA activity using a kinetic enzyme assay. Area under curve with respect to the ground for salivary cortisol (AUCg of sCort) and alpha-amylase (AUCg of sAA), and the diurnal slopes of sCort and sAA were calculated. Associations between AUCgs and diurnal slopes for sCort and sAA with diet were examined by logistic regression adjusted for age, gender, and the time difference between the first and last saliva sample collected.

Results: Belonging to the highest third of AUCg of sAA was associated with an increased likelihood of high consumption of all sugary food and with sugary beverages. Negative diurnal slope of sAA was related to a decreased likelihood of high consumption of sugary treats. Children with a slightly negative slope of sCort had an increased likelihood of low fruit and berries consumption. No associations were observed between AUCg of sCort and dietary variables.

Conclusions: We found an association between less optimal diurnal levels of sAA and higher sugary food consumption. Furthermore, less optimal diurnal slope of SCort associated with lower consumption of fruit and berries. Our findings support the metabolic-brain-negative feedback pathway theory according to which children may drift towards highly palatable, sugary foods when stress biomarker levels are higher.

Keyword: food consumption, children, salivary cortisol, salivary alpha-amylase

Conflict of Interest Disclosure: Liisa Korkalo was a board member of the company TwoDads at the time of the study. The authors declare that they have no other conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-50
Iron bioaccessibility, absorption and efficacy from reformulated infant cereals in young children

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Background: Based on 2011 global estimates, 43% of preschool children were anemic, with the highest burden in Africa and South Asia. The etiology of anemia varies and is complex, and recent estimates suggest that 25% is associated with iron deficiency (ID). ID arises when physiological requirements are not met, and iron fortification is generally regarded as the most cost-effective and sustainable long-term approach to decrease its prevalence. To this end, we evaluated the impact of iron fortification of infant cereals (IC) made with refined flours on the prevalence of anemia or iron deficiency anemia (IDA) in young children.

Objective and results: We show that daily consumption of multi-micronutrient fortified ICs including iron for 6 months significantly improved iron status and reduced the risk of IDA in intervention trials conducted in Cameroon, Ghana, and India, involving children aged 6–59 months and using robust biomarkers and clinical outcome measures. However, whole grains are preferred to refined flours, and legumes could be a more favorable source of protein vs. milk but both contain inhibitors of iron absorption. Thus, the impact of IC reformulation, with these two ingredients, on iron absorption was evaluated with *in vitro* simulated digestion coupled with the Caco-2 cell model. The results from recipes with flour from lentils and whole grains suggested some improvement of the iron uptake by the cells, whereas with chickpeas and whole grains flour the iron uptake was impaired compared with that from IC based on refined flour. Finally, these recipes were compared for their impact on iron absorption in children (6 to 14 months) with ID and/or IDA using the erythrocyte incorporation of labelled iron 14 days post consumption of these ICs in a clinical study. The results showed that in the presence of ascorbic acid, iron absorption of reformulated ICs was not significantly different than from IC based on refined grain, with significant contributions to the requirement for absorbed iron (i.e., 33 to 57% with one serving).

Conclusion: Therefore, the efficacy of ICs containing pulses, whole grain, and ascorbic acid is expected to be similar to that from IC based on refined flours.

Keyword: iron, cereals, bioaccessibility, bioavailability, bioefficacy

Conflict of Interest Disclosure: N. P. Hays, M. Sabatier are employees of Société des Produits Nestlé S.A., Switzerland

PAB(T3)-51
Empowering pregnant women to improve diet quality: Results from a randomized controlled trial among pregnant women in the Netherlands

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Background and objectives: A healthy diet during pregnancy is crucial for the health of both mother and child, but pregnant women often do not meet the nutritional requirements. Empowering pregnant women is a process to increase their power or control. Growing evidence shows that empowerment interventions can lead to improved health outcomes. However, empowerment has been rarely used in nutritional interventions. Empowering pregnant women to improve their diet quality could play a significant role in improving maternal nutrition. Based on research and input from pregnant women, midwives, and dieticians, we developed Power 4 a Healthy Pregnancy (P4HP) – an intervention facilitating four additional consultations for the pregnant women to discuss nutrition from an empowerment perspective. Three consultations with a midwife, and one with a dietician. Our objective is to evaluate P4HP on diet quality, empowerment levels, and three health-related factors: Sense of Coherence (SOC), Self-Rated Health, and Quality of Life.

Methods: A cluster randomized controlled trial started January 2022 in 14 Dutch midwifery practices – 7 intervention and 7 control. Each practice recruits 25 pregnant women, resulting in a total of 350 participants. Women in the intervention group follow P4HP in addition to their usual birth care. Measurements are carried out at the beginning and end of pregnancy. Diet quality is assessed using the Dutch Healthy Diet index 2015, validated with 24h dietary recall and FFQ data, specifically adapted for pregnancy. Empowerment is assessed using the Pregnancy-Related Empowerment Scale, SOC using a three-item SOC questionnaire, Self-Rated Health using a General Self-Rated Health question, and Quality of Life using a Visual Analogue Scale. Results will be analyzed using Linear Mixed Models as this allows to analyze the treatment effect of clustered data.

Results: We hypothesize that four additional consultations for the pregnant women to discuss nutrition from an empowerment perspective with both a midwife and a dietician will lead to improvements in diet quality, empowerment levels, and health-related factors among the intervention group compared to the control group.

Conclusions: Our findings will present new knowledge about the possibilities of empowerment in nutrition promotion. We expect to present our preliminary results during the congress.

Keyword: Diet quality, empowerment, pregnancy, maternal nutrition

Conflict of Interest Disclosure: Not aplicable

Further Collaborators: Not applicable

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-52

Individual but together - the key to success? Value of the personalized nutrition approach to weight loss programs using the example of ProSeni

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Introduction and objectives: Weight loss in old age in overweight women is significant for maintaining health, but studies show large interindividual differences in weight loss, which diminishes the benefit for individuals. The ProSeni study demonstrates the success of a personalized nutrition approach to weight loss in older overweight women.

Methods: 54 postmenopausal overweight women were participated in a 12-week weight-loss study (-750 kcal from total energy expenditure), followed by a 6-months follow-up phase. A personalized nutrition approach was used, with participants receiving a total of 51 individualized daily meal plans based on a detailed diet history with their preferences and aversions. In addition, there were four group training sessions that focussed on participation and empowerment during intervention time. Participants had to keep food diaries for two 7-day periods and fill out food checklists on all other days. Continuous face-to-face conversations and telephone calls were recorded in key point form.

Results: 46 women completed the study and 29 were followed up (t_2). Weight loss was - 5.8 ± 3.0 kg at post-intervention and - 4.9 ± 5.4 kg (both $p < 0.001$) at t_2, respectively. A higher energy deficit was associated with a higher loss of fat-free mass kg ($r = -0.51$; $p<0.001$). The appreciative and individualized approach ensured good access to the women, which underscores the validity of the study results. This demonstrated the strong correlation of the energy deficit recorded within the food diaries and the real weight loss ($r=0.9$, $p < 0.001$).

Conclusion: The approach of personalized nutrition is very elaborate but effective in terms of weight loss in postmenopausal overweight women. It is also important to communicate a slow and sustainable weight loss in order to maintain fat-free mass and counteract sarcopenia.

Keyword: personalized nutrition , weight loss, older age

Conflict of Interest Disclosure: The authors have no conflict of interests to declare.

PAB(T3)-53

Light breakfast increases appetite before lunch but may not increase energy intake in Japanese healthy female young subjects.

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Background and Objective Breakfast is the most easily missed meal of the day and tends to be quick and easy. Skipping breakfast at a young is a growing problem that is associated with over-and under- nutritional intake in Japan. The objective of this study was to determine if there was a beneficial effect of a light breakfast on daily nutritional intake, appetite, and physical activity.

Methods: This intervention study recruited 12 healthy female undergraduates aged 19-23 years who were habitual breakfast eaters. They were instructed to eat a prescribed breakfast of skip (0 kcal only water), light (120-240 kcal), medium (360-480 kcal), and full (600-720 kcal) and allowed to consume freely any subsequent lunch, dinner, or snack. Energy and macronutrient intake were evaluated by their photographic food records. Appetite before lunch and dinner on the day of the prescribed breakfast was measured using a visual analog scale (VAS). The amount of physical activity (resting time, activity time, and step count) was measured during the day using a 3-axis accelerometer.

Results: When comparing the four groups according to prescribed breakfast energy intake: skip, light, medium, and full, the daily energy intake was 1,270 kcal/day, 1,524 kcal/day, 1,598 kcal/day, 1,884 kcal/day respectively. Only full breakfast days showed a significant difference compared skip days. There was no significant difference in energy intake at lunch, dinner, or snacks even though appetite VAS before lunch was significantly higher on skip and light breakfast days than on full breakfast days. The daily resting time on medium and full breakfast days was significantly shorter than on skip breakfast days but did not significantly shorten on light breakfast days.

Conclusions: Our results suggest that energy intake at breakfast may affect daily energy intake. Light breakfast (120-240 kcal) increases appetite before lunch as on skip breakfast day but did not increase daily energy intake in young females who habitually eat breakfast.

Keyword: Intervention study, Breakfast, Energy intake, Appetite, Young women

Funding: This work was supported by JSPS KAKENHI Grant Number 19K20190.

Conflict of Interest Disclosure: No COI to disclose.

Further Collaborators: This work was supported by JSPS KAKENHI Grant Number 19K20190.

PAB(T3)-54
Prevalence of gastrointestinal symptoms in presumed healthy infants: a cross-sectional study in China

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Background and objective: Studies show that the prevalence of gastrointestinal (GI) symptoms, as assessed by the cow's milk-related symptom score (CoMiSS™), is low (median 3.0) in presumed healthy European infants. To our knowledge, no previous studies have been conducted on the prevalence of GI symptoms as assessed by the CoMiSS in presumed healthy Chinese infants. This cross-sectional study observed the GI comfort in Chinese infants under 6 months old.

Methods: A short online questionnaire was sent to parents of infants under 6 months old exclusively consuming human milk (HM) or infant formula (IF) via WeChat, with an aimed total of 1200 respondents. Questionnaires included the CoMiSS, range 0-33 points, and the infant gastrointestinal symptoms questionnaire (IGSQ), range 13-65 points. In both questionnaires higher scores indicate more GI discomfort. Moreover, the abbreviated WHO quality of life questionnaire (WHOQOL-BREF), ranging to 0 (worst) to 100 (best), and the baby eating behaviour questionnaire (BEBQ), subscales ranging from 1-5 points, were administered. Descriptives and general linear models were computed using SAS.

Results: Preliminary data consisted of questionnaires of 390 infants, of which questionnaires with incomplete data was excluded (n=70). We observed that prevalence of GI symptoms was low with a mean CoMiSS of 2.2 (SD 2.4) and a mean IGSQ of 18.8 (SD 5.7). Only 5% of the study population had a higher COMISS than 6, indicating mild GI discomfort. No statistically significant differences in CoMiSS or IGSQ were observed between infants that consumed HM or IF. The mean WHOQOL was generally high [69.9 (SD 13.8)] and was not significantly different between HM-fed and GMF-fed infants. The BEBQ domains general appetite and enjoyment of food were high (4.1 SD 0.9; 4.1 SD 0.7; respectively) whereas scores were low for the domain satiety responsiveness (2.4 SD 0.6) and slowness in eating (2.4 SD 0.7). All BEBQ domains appeared similar among groups.

Conclusion: Prevalence of gastrointestinal symptoms as assessed by CoMiSS and IGSQ is low in presumed healthy Chinese infants and comparable to previously reported prevalence in presumed healthy European infants. Data of another 800 infants are expected in June 2022.

Keyword: infant nutrition, gastro-intestinal symptoms, infant formula, CoMiSS, China

Conflict of Interest Disclosure: Disclosure of Interest: Yvonne Meijer-Krommenhoek, Lucie van der Zee and Linde van Lee are employees of Ausnutria B.V., producer of infant formula. Jinjing Zhong, Yanmei Hou, Kui Xie, Yiling Deng and Junlan Ma are employees of Hyproca Nutrition China, producer of infant formula

PAB(T3)-55
The Influence of Maternal Diet on the Breast Milk Composition and Clinical Health Outcomes in Infants; a sub-study within the PRIMA Birth Cohort

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Background and objectives: Breastfeeding provides the optimal nutrition for infants to ensure a healthy development. Many components in breastmilk contribute to a variety of health outcomes for infants, including significant protection against respiratory tract infections. There are strong indications that the composition of breastmilk is influenced by the maternal diet. We aim to explore whether maternal diet affects levels of breastmilk components which play a role in the protection against respiratory tract infections in early life. To our knowledge, we are the first to study the influence of maternal diet on the composition of breastmilk, coupled to the risk of developing respiratory infections.

Methods: The objective is pursued with a nested sub-study within the PRIMA (Protecting against Respiratory tract Infections through human Milk Analysis) birth cohort of 1000 mother-infant pairs. We aim to recruit 250 mother-infant pairs in the surroundings of Utrecht, the Netherlands. Breastmilk samples are collected at 1 and 3 month(s) postpartum. Both the long-term and short-term influence of the maternal diet on these samples are assessed with a food frequency questionnaire and 24h dietary recall, coupled to each of the sampling moments. Infants are followed up to their first birthday for both parent- and physician reported respiratory tract infections. In addition, feces and saliva samples of the infant at 3 months of age are collected in order to link breastmilk composition to microbiota composition and antibody repertoire, respectively.

Results: The first step is to analyze dietary intake of lactating mothers at different stages of lactation. Dietary assessment of the second and fourth month postpartum, by means of food frequency questionnaires, allows to evaluate whether the maternal diet changes over lactation time, and if this is influenced by factors such as status of breastfeeding, pre-pregnancy BMI and whether the mother has returned to work or not. This is a first step towards dietary advice for lactating women in order to optimize the breastmilk quality for their infant.

Conclusions: To conclude, this nested sub-study will give insights of the potential of maternal diet in order to improve the protection of infants against respiratory tract infections with breastmilk.

Keyword: Maternal diet, Human milk, Breastfeeding, Respiratory tract infections, Child health

Conflict of Interest Disclosure: This research was supported by Regio Deal Foodvalley (grant nr. 162135).

PAB(T3)-56

Health and nutrition assessment is useful for the community dwelling elderly receiving meal delivery service in Japan

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Background and objectives: In super-aged society in Japan, nutritionally sound meal delivery service is crucial for the community dwelling elderly at risk of undernutrition. In this study, we conducted a health and nutrition survey for 1,107 Japanese elderly people aged 65 years or older (605 men and 502 women) who appointed to receive a meal delivery service supervised by dietitians, in order to investigate possible eating function-related factors associated with undernutrition.

Methods: Mini-Nutritional Assessment –Short Form (MNA-SF) and a questionnaire for health/nutrition status including eating function, subjective health, and frequency of going-out were used to assess health and nutrition status of the subjects, who lived in four cities in Kanagawa and Shizuoka prefectures in Japan.

Results: A major age group of the subjects was 80 years or older (46 % of male and 57% of female), and 14% of male and 24% of female possessed certification of needed long-term care. MNA-SF showed that 42% of men and 53% of women were either "at risk of undernutrition" or "undernutrition". By the criteria of lower BMI less than 20.0, 21% of men and 36% of women were categorized in at risk of undernutrition. The nutrition scores based on MNA-SF were significantly associated with the years of meal delivery service in men, and the scores were associated with lack of misswallowing, lack of dry mouth, ability to bite with the back teeth, subjective health status, and frequency of going-out in both mae and female.

Conclusions: Health and Nutrition assessment is usefull to identify the personal needs of community dwelling elderly who require a meal delivery service seeking prevention of frail and undernutrition.

Keyword: community dwelling elderly, meal delivery service, undernutrition, eating function, frail

PAB(T3)-57

Association between a-priori and a-posteriori dietary patterns and depressive symptoms in community-dwelling older adults: results from the cross-sectional NutBrain Study.

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1. Italian National Research Council - CNR (Italy), 2. IRCCS Mondino Foundation (Italy)

Background and objectives: An emerging body of evidence has suggested that diet plays an important role in mental disorders like depression, but more research in older people is still necessary. This study aims to investigate the association between *a*-priori and *a*-posteriori dietary patterns (DP) and depressive symptoms in community-dwellers older adults.

Methods: NutBrain is an Italian ongoing cross-sectional study of adults aged ≧65 years living in Northern Italy. At baseline, socio-demographic characteristics along with dietary, medical, and neuropsychological data were recorded using validated questionnaires. Depressive symptoms were assessed through the Center for Epidemiologic Studies Depression (CES-D) scale. The *a*-priori Mediterranean Diet score (MDS) was calculated based on a 102-semi-quantitative food frequency questionnaire. Nutrients and energy intake was calculated using the Italian food composition database. *A*-posteriori nutrients DP were derived using principal component analysis based on 28 micro- and macronutrients. To estimate odds ratios (OR) with 95% Confidence Intervals (CI) of depressive symptoms (CES-D≧16), multivariate logistic regression models were used, adjusting for sex, age, education, living status, energy intake, physical activity, smoking status, and polypharmacy.

Results: Among the 425 participants recruited (mean age 74.0 years ± 6.5 SD, 59.9% females, 48.7% high education), 18.8% reported depressive symptoms. Compared with participants without depression, those with depressive symptomatology were mainly females (83.3%), lived alone (36.3%), had low education (26.9%), and had low adherence to MDS. Five major DP were identified: Plant-, Meat and dairy-, Plant-derived fats, Starch-, and Fish products. In the multivariate-adjusted model, the highest vs the lowest tertile of MDS score was associated with a reduced probability of having depressive symptoms (OR 0.23, 95%CI 0.10-0.50). Plant- (OR 0.37, 95% CI 0.17-0.82), and Fish products (OR 0.47, 95%CI 0.24-0.93) were associated with reduced odds of depression. Other DP were not appreciably associated with the outcome.

Conclusion: These findings suggest that older adults following healthy dietary habits characterized by high consumption of fruits, vegetables, legumes, whole grains, and fish have fewer depressive symptoms. The current study indicates that dietary interventions have the potential to be included as a primary prevention strategy for depression even in the old population.

Keyword: Dietary patterns, Depressive symptoms, Older adults, Cross-sectional study

Conflict of Interest Disclosure: None

PAB(T3)-58

Relationship between anthropometric variables and the shape of Senegalese children aged 6-59 months suffering from moderate acute malnutrition

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Background and objectives: Community-level screening is essential for identifying children aged 6-59 months suffering from acute malnutrition as well as saving lives, but several issues can cause misdiagnosis and lead to reduced coverage. Since 2015, Action Against Hunger has developed an alternative real time and image-based screening tool for severe acute malnutrition (SAM), named SAM Photo Diagnosis App®. The first results from studies carried out with this technology have described the morphological variability of SAM children and the accuracy of shape variables to identify SAM or moderate acute malnutrition (MAM). However, the relationships between morphogeometric and anthropometric characteristics of MAM children have not been explored in depth. This study aimed to analyse the relationship between the morphogeometric component of the left arm of MAM children and their anthropometric variables.

Methods: A cross-sectional study was carried out on 91 MAM children aged 6-59 months living in Senegal. Weight, height and mid-upper arm circumference (MUAC) were measured and anthropometric indicators: weight-for-height (WHZ), height-for-age (HAZ), weight-for-age (WAZ) and MUAC-for-age (MUAC-AZ) were estimated from the WHO reference standards. Pictures of the left arm were collected using SAM Photo Diagnosis App®. Twenty (20) anatomical landmarks were identified on the images and digitized into 2D-coordinates to obtain morphometric variables. Multivariate regression analyses of shape on anthropometric variables were performed with a confidence of 95%.

Results: The study shows a positive association between shape variables and weight (r=0.71; P<0.001), height (r=0.8; P<0.001), and MUAC (r=0.28; P<0.007), being the height the variable that explains the greatest variability in the shape (36.63%). A positive relationship between shape and WHZ (r=0.43; P<0.001), HAZ (r=0.23; P=0.02) and MUACAZ (r=0.35; P<0.001) was also evidenced. The highest amount of left arm shape variability was explained by WHZ (9.62%).

Conclusion: These results reveal a positive and significant relationship between anthropometric variables and shape. Height and WHZ are the variables that most influence morphogeometric variability in the left arm of children with MAM. This result will be considered in the process of developing and improving the SAM Photo Diagnosis App® tool.

Keyword: Geometric Morphometrics, Moderate Acute Malnutrition, Anthropometry, Shape variability, Multivariate regression

Conflict of Interest Disclosure: There is no conflict of interest either from financial or ethical aspect with this abstract within the last five years

PAB(T3)-59

Closing the capacity gap in quality nutritional counselling as part of improving antenatal and postnatal care services in Tanzania

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Background and objectives: Despite recent improvements in select nutritional indicators for children under five in Tanzania, only 59% of children under six months are exclusively breastfed, while 58% of children (6-59m) are anemic. Stunting remains problematic in key regions, with 56% of children under five stunted in Rukwa (TDHS, 2015-16). Antenatal (ANC) and postnatal care (PNC) services are entry points to counsel pregnant and lactating women on nutritional practices, yet health care workers' knowledge and practice varies greatly in terms of quality nutritional counseling. Through Lishe Endelevu, the USAID-funded program, strengthened the availability of quality nutritional counseling within ANC and PNC services in selected health care facilities through a training and mentorship approach.

Methods: A rapid assessment of 987 facilities showed that only 380 (18%) of 2,111 reproductive and child health (RCH) staff had training on nutritional counseling, while 158 (7.5%) had received onsite clinical mentorship. Lishe Endelevu implemented a package of training and three-month onsite mentorship for RCH providers in 600 health facilities in four regions of Tanzania.

Results: Lishe Endelevu trained 690 clinical mentors in quality RCH services, including nutritional counseling as part of ANC and PNC. Following the training, clinical mentors provided on-the-job training and mentorship to 1,367 RCH providers. Supportive supervision data show that 97% (115/118) of mentored RCH providers communicated health and nutrition counseling messages correctly to clients, as per IYCF standards, while 98% (116/118) delivered nutrition messages correctly per the counseling job aid. RCH providers noted that job aides had clear messaging, were easy to use, and improved time efficiency during nutritional counseling. During this time, Lishe Endelevu conducted client exit interviews with RCH clients to measure their experience. Overall, 69% (222/324) said the provider discussed the importance of nutrition and nutritional requirements during pregnancy, and 72% (218/303) reported the provider discussed the importance of exclusive breastfeeding for children under six months.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: Lishe Endelevu helped to close the capacity gap in quality nutritional counseling for RCH providers using an on-the-job training and mentorship approach. The model offered a fast, collaborative, and practical approach to transferring knowledge between healthcare workers.

Keyword: Antenatal and postnatal care, Tanzania, mentorship model, nutrition counselling

Conflict of Interest Disclosure: None

Further Collaborators: This work has been funded by USAID

PAB(T3)-60

Leveraging service delivery experiences from program partners: Key to integrating UNIMMAP MMS into existing ANC platforms in India

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Background and objectives: regnant women in low-resource settings are at an increased risk of food insecurity and poor diets that lead to multiple micronutrient deficiencies including iron, iodine, vitamin A, B12, C, D, and zinc. In India, around 52.2% of pregnant women are anemic- a discernible sign of other deficiencies. UNIMMAP's multiple micronutrient supplement (MMS) got included in the WHO Model List of Essential Medicines in 2021 and comprises of 15 essential vitamins and minerals to address the increased micronutrient requirements during pregnancy. This study explores the role of non-government organizations (NGOs) in improving access to MMS and how their service delivery can be leveraged toward integrating MMS into the existing antenatal care platforms.

Methods: Since 2012, Vitamin Angels (VA) India has distributed MMS to over 500,000 pregnant women through 1000 program partners. In 2021, VA conducted a qualitative assessment as part of a landscape analysis, to synthesize MMS implementation experience of 18 program partners across India. Respondents included heads of charitable trusts and hospitals, NGOs, and medical institutions.

Results: Program partners adopted the following strategies to optimize MMS implementation

Established strong government partnerships: Building strong partnerships with local government health authorities allowed program partners to connect with hard-to-reach communities.

Strengthened existing service delivery platforms: Leveraging MMS delivery through existing nutrition services provided opportunities for systems strengthening.

Created community buy-in by mobilizing health professionals: Facilitating MMS awareness among doctors, nurses, and health volunteers resulted in greater community receptivity to MMS uptake.

Diversified and expanded the reach of service delivery channels: Delivering services through a range of platforms like mobile health vans, community health camps, and ANC health facilities improved the reach.

Monitoring MMS uptake and adherence: Deploying monitoring strategies like physical records (including out-patient charts, community camp health records, and ANC registers) to track MMS uptake and adherence.

Conclusion: This work highlights the importance of leveraging both government and non-government service delivery platforms to ensure increased coverage and equitable reach of nutrition interventions such as UNIMMAP MMS. Further implementation research is required to understand how NGO service delivery platforms can be optimized to improve MMS access and acceptability.

Keyword: Pregnant women, Micronutrient deficiencies, UNIMMAP- MMS, Evidence-based nutrition interventions

Conflict of Interest Disclosure: None

Further Collaborators: The authors acknowledge the generous support provided by Kirk Humanitarian that helped make the activities represented in this article possible.

PAB(T3)-61

Prevalence of morbidity symptoms among women in the iLiNS-DYAD trials in Ghana and Malawi: a secondary outcome analysis

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Background and objective: Maternal small-quantity lipid-based nutrient supplements (SQ-LNSs) are beneficial for birth outcomes, but less is known about their impact on maternal morbidity. We aimed to examine the period prevalence and percentage of days with morbidity symptoms among women in 2 randomized controlled trials of SQ-LNS.

Methods: From enrolment (≦ 20 wk gestation) to 6 mo postpartum, Ghanaian (*n* = 1320) and Malawian (*n* = 1391) women were assigned to consume daily: 60 mg iron and 400 µg folic acid until childbirth and placebo thereafter (IFA group); or 18 vitamins and minerals including 20 mg/d iron (MMN); or 20 g/d SQ-LNSs containing the same micronutrients as the MMN plus 4 additional minerals. Within country, we compared the period prevalence and percentage of days with fever, gastrointestinal, reproductive, and respiratory symptoms during the second and third trimesters of pregnancy and 0-3 and 3-6 mo postpartum using repeated measures logistic regression and repeated measures ANOVA.

Results: In Ghana, groups did not differ in the morbidity outcomes except for mean (SD) percentage of days with nausea,

which was greater among the LNS (4.0 (11.9)) and MMN (3.9 (10.6)) women than IFA (3.6 (8.3)) women in the third trimester (P=0.04), and among the LNS (0.7 (3.9)) than MMN (0.6 (3.5)) and IFA (0.6 (3.1)) women at 0-3 mo postpartum (P=0.03). In Malawi, only the period prevalence of severe diarrhea at 3-6 mo postpartum differed by group, with higher prevalence among the LNS (5.6%) and IFA (5.4%) women than MMN (4.5%) women (P=0.041).

Conclusión: The period prevalence and percentage of days with fever, reproductive, and respiratory symptoms do not differ between women who receive SQ-LNS, MMN or IFA. The differences in prevalence of nausea (Ghana) and severe diarrhea (Malawi) are small and possibly due to chance. *Clinicaltrials.gov identifiers:* NCT00970866; NCT01239693.

Keyword: small-quantity lipid-based nutrient supplements, multiple micronutrient supplements, maternal morbidity, common morbidity symptoms

Conflict of Interest Disclosure: No conflict of interest

PAB(T3)-62
Acceptance of orange-fleshed sweet potato blend as complementary food for infants and young children in Sierra Leone

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Background: Consumption of micronutrient rich foods remains sub-optimal among children in Sierra Leone. A National Nutrition Survey conducted in 2021 showed 26% of children U5 are stunted, only 23% of children 6-23 months of age receive MDD and 85% cannot afford a diet that supports long-term health. OFSP is a rich source of pro-vitamin A. Helen Keller International, in collaboration with the Ministry of Health and Sanitation formulated nine blends with OFSP flour for children. The blends also contained locally-sourced sorghum, sesame, pigeon-pea or soya.

Objective: To use consumers' preferences to guide selection of the most acceptable blend for a locally-produced, nutrient-rich, ready-to-use commercial food product that could compete price-wise with imported products marketed nation-wide.

Methods: To reflect a diversity of potential consumers, caregivers of children were purposively sampled in three districts and across three age categories: 6-23 months, 2-5 years, and 6-12 years old. An organoleptic test was conducted with 30 participants from each age category totaling 90 participants per district (total 270). The samples were labelled F1-6 (without soya) randomly tasted by 120 children from all three groups in the ratio (1:2:1 or 1:1:2) and others SF1-3 (containing soya) randomly tasted by 30 children from the 6-23 months category alone. The researchers explained the purpose of the study and how to rank the different flours using criteria of acceptability to both mother and child: ease of preparation, color, taste, smell, texture and appearance. Each sample was ranked based on 1=Strongly dislike; 2=Dislike; 3=Okay/fine; 4=Like; 5 Really like, and means calculated for each blend.

Results: The results identified two blends with texture being the main differentiating factor, rough texture ranked poorly versus smoother texture. This feedback guided a slight modification that also took the nutritional value and consumer price into consideration. This lead to a new product branded 'PetetePap' that, including a vitamin-mineral premix, was certified by the National Standards Bureau as suitable for consumption by young children.

Conclusion: A locally-produced OFSP flour was deemed acceptable by caregivers of children above 6 months of age. Next steps will be testing willingness to pay and feasibility of marketing by women traders**.**

Keyword: children feeding, dietary diversity, vitamin A, food security, local content

PAB(T3)-63
Consumption of differing frequencies, varieties, and amounts of fruit & vegetables among children 6-23 months of age and their association with dietary and health outcomes: a systematic narrative syntheis

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Background and objectives: Suboptimal breastfeeding and complementary feeding practices, when combined with infectious diseases, are the leading causes of malnutrition during the first two years of life, and continue to be highly prevalent, especially in LMICs. The objective of this review was therefore to assess the impact of complementary feeding practices, in terms of differing frequencies, varieties, and amounts of fruit and/or vegetable (FV) consumption, on dietary and health outcomes in children aged 6-23 months.

Methods: We evaluated primary studies of experimental and observational design that reported FV consumption (reported as frequency, variety and/or amount consumed) in healthy children aged 6-23 months. Qualitative studies and reviews were excluded. Electronic databases (MEDLINE, Embase, CINAHL, LILACS, AIM, CENTRAL, eLENA) and grey literature were searched using appropriate keywords, MeSH, and free text terms. Screening, data extraction and risk of bias assessments (ROB-2 tool for RCTs; NIH tool for observational studies) were completed in duplicate. GRADE assessments were conducted to evaluate the certainty of the evidence.

Results: We included 17 studies that analyzed data from 37,550 children aged 6-24 months at time of dietary data measurement. Eight studies were conducted in HICs and nine

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

studies from LMICs. We found very low certainty evidence for less frequent consumption of FV with higher likelihood of stunting and underweight. Conversely, more frequent consumption of FV was associated with higher likelihood of being overweight, improved linear growth, reduced likelihood of anemia, and higher scores for child development based on very low certainty evidence. Very low certainty evidence pointed to an association between greater amounts of fruit consumed with increases in waist circumference. Lastly, more varied and more frequent consumption of FV during the complementary feeding period was associated with improved subsequent consumption and taste preferences of FV items later in life.

Conclusion: This review suggests that more frequent and varied consumption of FV during infancy is associated with improved FV consumption later in life. However, higher quality research is needed to confirm this finding, and overall, this review has highlighted a major gap in the evidence, underscoring the need for more research to be conducted on this topic.

Keyword: complementary feeding, infants and young children, fruits and vegetables, nutrition, consumption

Conflict of Interest Disclosure: No conflicts of interest

Further Collaborators: WHO IYCF Guideline Development Group

PAB(T3)-64
Nutritional care for children with feeding difficulties and disabilities: A scoping review

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1. JSI Research & Training Institute, Inc. (USA), 2. Save the Children (USA)

Background and objectives: One billion people worldwide have a disability, and 80 percent of them live in LMICs. The prevalence of feeding problems ranges from 25 to 45 percent in non-disabled children and 33 to 80 percent in children with disabilities. USAID Advancing Nutrition conducted a scoping review of nutrition programs focused on supporting nutritional care of children with disability and non-disability related feeding difficulties.

Methods: The scoping review included a desk review of peer-reviewed and gray literature, as well as existing tools. In all, 102 documents identified through keyword searches and snowballing met the inclusion criteria. We also conducted 42 key informant interviews with experts in nutrition and disability. Findings were organized using structured matrices following the Nurturing Care Framework's Universal Progressive Model based on challenges and opportunities in these areas: (1) the prevalence of feeding difficulties, (2) identification of children with feeding difficulties or disabilities, and (3) support to manage feeding difficulties.

Results: The review found insufficient policies, programs, and evidence to support children with feeding difficulties and their families. While some resources exist to identify and support these children, they are not standardized or universally used, staff are not trained to use them, and there is not enough funding to implement them. The combination of challenges in identifying disabilities and feeding difficulties, a lack of understanding of the link between disabilities and feeding, and weak or nonexistent referral or specialized services, puts these children at risk of malnutrition. Additionally, their families face challenges providing the care they need, including coping with high care demands, accessing support, obtaining appropriate foods, and managing stigma. The review also found innovative examples that may be replicated elsewhere.

Conclusions: Four areas of recommendations emerged to support children with feeding difficulties and disabilities. 1. Strengthen systems to improve identification and service provision, and expand the availability of feeding services. 2. Provide direct support to families to address determinants that affect nutrition outcomes. 3. Conduct advocacy to raise awareness of the needs and opportunities. 4. Build the evidence base on effective interventions to identify and support these children and their families.

Keyword: disability, feeding difficulties, health systems

Further Collaborators: Kristen Cashin (affiliation: Save the Children), Jamie Gow (affiliation: U.S. Agency for International Development), Altrena Mukuria (affiliation: Save the Children), Jennifer Yourkavitch (affiliation: Results for Development), Katie Beck (affiliation: The Manoff Group)

PAB(T3)-65
An evaluation study on promoting holistic nurturing care into nutrition delivery systems to improve early childhood outcomes in Mozambique

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Background and Objective: The Nurturing Care Country Profile data for Mozambique show that less than half (41 percent) of infants under 6 months of age are exclusively breastfeed, only 11 percent of children have a minimum acceptable diet, 33 percent are engaged in activities that promote early learning, and only 3 percent have playthings at home (UNICEF 2019). Thus, in Mozambique, caregivers need support to provide nurturing care for young children, particularly around adequate nutrition, responsive care, and early learning. USAID Advancing Nutrition is addressing this gap by supporting the local consortium, Transform Nutrition (TN) to improve early childhood development (ECD) by integrating responsive care and early learning in community-based sanitation and hygiene (SH) and nutrition services delivered through peer groups and home visits.

Methods: The study will employ a mixed-methods design to estimate program impact on children's ECD outcomes and will use qualitative and quantitative data to understand the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

implementation fidelity and quality. A random sample of around 900 caregiver-child dyads (children 0 to 2 years) from 12 districts in Nampula Province will participate in caregiver surveys, interviews, focus groups, child anthropometric assessments, and child assessments. The Ages and Stages Questionnaire (ASQ 3), and the Global Scale for Early Development (GSED) Short Form, Long Form, and Psychosocial Form will be administered at baseline (2022) and end line (2023). This study will also provide data to validate the GSED measure.

Results: Study findings will indicate if the integration of responsive care and early learning, particularly through caregiver counseling, has a greater effect on ECD outcomes compared to the nutrition/SH intervention alone. Results will also provide evidence on the feasibility, acceptability, and experience of integration. Finally, this study will provide evidence on validation of the GSED measure.

Conclusions: Findings from this study have the potential to be used by USAID Mozambique and other stakeholders who are considering integrated approaches to improve children's development outcomes and contribute to the global evidence base on measuring child outcomes for children 0–2 years.

Keyword: responsive care, early learning, early childhood development, counseling, global child development measures

Further Collaborators: Romilla Karnati (Save the Children), Higino Cresencio Andre (Save the Children), Alberto Manhiça (Save the Children), Jamie Gow (USAID)

PAB(T3)-66
Diversity of vegetables and fruit in children's diet in Finland and association with parental educational level

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Background and objectives: A high diversity of different vegetables and fruit in the diet is suggested to be associated with health benefits. Our aim was to describe the vegetable and fruit diversity in the diet of 3- to 6-year-old children in Finland and to analyse whether it is associated with parental educational level.

Methods: We used data from the cross-sectional DAGIS Survey carried out in eight municipalities in Finland in 2015-2016 (n=864). Parents and early childhood education and care (day care) personnel kept a 3-day food record for each child. For this analysis, we included 3- to 6-year-old participants with 3 complete days in the data (n=766). We disaggregated composite dishes into ingredients, coded all vegetables and fruit (including fresh, cooked, frozen, canned) into categories, and calculated the consumption in grams. We also constructed a 3-day vegetable and fruit diversity score using a variable where 1 indicated a minimum of 10 gram consumption of a category in a day and 0 indicated less or no consumption on that day. We grouped fruit juices and fruit soups as a single category 'fruit juices' regardless of the number of species the product was made of. The final score was the sum of unique categories consumed during 3 days. Finally, we used a hierarchical linear model to analyse whether parental education level (3 categories) was associated with the child's score.

Results: The top ten categories, in descending order of the amount consumed in grams, were fruit juices, apple, banana, cucumber, carrot, tomato, all types of mandarins, pear, strawberry, and grapes. The median (25^{th}; 75^{th} percentile) diversity score was 10 (8; 13). The highest parental educational level was associated with a higher variety score in the child's diet compared to the lowest parental education. The association remained significant after adjusting for child's age and sex.

Conclusions: Parental educational level was positively associated with the fruit and vegetable diversity of children's diets. Serving a large variety of different vegetables and fruit at the day care meals could be an opportunity to increase the vegetable and fruit diversity in children's diets regardless of their socioeconomic background.

Keyword: dietary diversity, variety, vegetables, socioeconomic status, preschool

Conflict of Interest Disclosure: Liisa Korkalo was a board member of the company TwoDads at the time of the study.

PAB(T3)-67
Impact of the second wave of COVID-19 pandemic on the nutritional habits of Romanian youth

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Background and objectives This study aims to document the impact of the second wave of Covid 19 pandemic on the nutritional habits of Romanian youth.

Methods The study was performed during the second wave of COVID-19 pandemic in Romania (October 2020-February 2021) when due to epidemiological situation schools and faculties offered mainly online educational activities. Data collection was performed by means of online questionnaires among 457 medical students from one medical faculty from Cluj-Napoca, Romania and 481 school children aged 10-15 years from 7 schools situated in urban areas from 2 counties of the country. One section of the questionnaire investigated how the food consumption in the last two weeks differed from the same period, but one year before, when the pandemic was not in place.

Results The results show that for both groups the most stable consumption was declared for meat, dairy products and bread (more than 60% declared that the consumption was similar with the period before pandemic). Among medical students the highest decrease was noticed for fast food products

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(for more than half of the participants) and bought cooked food (for more than 40%) followed by decrease in consumption of processed meat products (such as salami, sausages) and sweets for around one third of the participants. Among school pupils the strongest decrease was with regard to consumption of chips and snacks as well as soft drinks (for around 40% of them) followed by the decrease in consumption of bought cooked food (around one third) as well as processed meat products and sweets (the percentage was a bit lower than 30%). Eating home cooked food increased for more than half of students and one out of thee pupils. The consumption of fresh fruits and vegetables increased for more than one third of both students and pupils. Several differences were noticed based on gender, nutritional knowledge and education.

Conclusions The study contributes to the body of literature regarding the impact of COVID-19 on different population groups and formulate recommendations for future research and practice during the recovery period.

Keyword: COVID-10, nutritional habits, Youth, Romania

PAB(T3)-68
Testing the responsive care and early learning addendum to improve early childhood outcomes in Ghana and the Kyrgyz Republic

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Background and Objective: Research shows that children who receive a combination of nutritional and nurturing care interventions have improved nutrition and early childhood development outcomes. Therefore, USAID Advancing Nutrition is pilot testing the integration of a new responsive care and early learning [RCEL] Addendum package (two components of nurturing care) with the widely used nutrition package—UNICEF Community-Based Infant and Young Child Feeding (C-IYCF) Counseling Package—in Northern Ghana and the Kyrgyz Republic to assess the feasibility, acceptability, and effectiveness of the RCEL Addendum to promote optimal early childhood outcomes.

Methods: USAID Advancing Nutrition is using a mixed method design to conduct implementation research. Baseline data will be collected in March–April 2022 and monitoring data will be collected throughout implementation between April and October 2022. The study includes multiple data collection components, including a pre-post survey design, focus group discussions, individual interviews, and pre-post training evaluations to answer six research questions in Ghana and five research questions in the Kyrgyz Republic related to the feasibility, acceptability, and effectiveness of the package.

Results: While results of the studies are pending, they are expected to illustrate the feasibility of adapting a generic reference material to different country contexts, highlighting key points where adaptation was necessary. Results will also provide evidence on the efficacy of the training program, following the cascade of the training to the community level, to enable frontline workers to deliver the Addendum context. Results will also provide insights into the feasibility of delivering the package, examining barriers and enablers to its effective implementation, such as the value of on-the-job coaching through supportive supervision. Last, endline results will provide evidence on the efficacy of the package to support behavioral changes related to RCEL practices among the study population (caregivers of children under two).

Conclusions: Overall, the study will provide evidence on the feasibility, acceptability, and efficacy of implementing the Addendum in two unique contexts, though existing government systems, and will offer insights into how such an integrated package may impact early childhood development outcomes.

Keyword: responsive care, early childhood development, feeding difficulties, counseling, implementation research

Conflict of Interest Disclosure: None

Further Collaborators: Malia Uyehara (JSI Research & Training Institute, Inc), Kristen Cashin (Save the Children), Jamie Gow (USAID), Andrew Cunningham (JSI Research & Training Institute, Inc), Peggy Koniz-Booher (JSI Research & Training Institute, Inc), Yunus Abdulai (JSI Research & Training Institute, Inc), Nazgul Abazbekova (JSI Research & Training Institute, Inc), Aida Shambetova (JSI Research & Training Institute, Inc), Katie Beck (The Manoff Group), Romilla Karnati (Save the Children), Begimai Zhumgalbekova (JSI Research & Training Institute, Inc), Madina Olomi (JSI Research & Training Institute, Inc), Fauzia Abukari (JSI Research & Training Institute, Inc).

PAB(T3)-69
Proliferation of marketing of breastmilk substitutes and complementary foods for infant and young children through various online platforms in the Philippines

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Background and Objective: The Philippine Milk Code was enacted in 1986, with its Implementing Rules and Regulation (IRR) revised in 2006, in response to the International Code of Marketing of Breastmilk Substitutes (The Code) and relevant World Health Assembly Resolutions to impose strict regulations on advertising, promotion, and marketing of breastmilk substitutes (BMS) and commercially available complementary food (CACF) products. The Philippine Milk Code is substantially aligned with The Code including prohibiting the advertising or other form of promotion to the general public of the products within the scope of The Code. However, the revised IRR does not cover online marketing. We aimed to determine the extent of

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

proliferation of marketing of breastmilk substitutes and complementary foods through various online platforms.

Materials and Methods: This study was conducted from February 5 to March 25, 2020. Presence of marketing and health and nutrition messages on BMS and CACF products were assessed by monitoring online retail platforms available in the Philippines such as Shopee, Lazada, Galleon, Carousell, and Baby Mama. Promotion types and health and nutrition claims on the product packages were recorded.

Results: A total of 33 product promotions were found in online retail platforms during the 8 weeks of monitoring. 30% were related to BMS products and 70% were attributed to CACF. Product promotions were either price discounts, or incentives to purchase products, or both. On the other hand, review of the product's package revealed the presence of health and nutrition claims in some of the BMS and CACF products. Examples of messages recorded were that products enhance child intelligence; build the immune system; are a source of nutrients such as iron, bifidus, Vitamins B1 and C, and fiber; are healthy; and that the formulations are new or improved.

Conclusion: There was a proliferation of various types of promotions on BMS and CACF products in online retail platforms. The lack of provisions in the Philippine Milk Code regulating the marketing of BMS and CACF products in online channels can undermine optimal infant and young child feeding practices. The review and revision of the IRR to include regulation of the selling of BMS and CACF products through online retail platforms should be fast tracked.

Keyword: Breastmilk substitutes, complementary foods, marketing, promotion, online retail platforms

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T3)-70
Evaluation of dietary habits on the prevention for physical frailty in the community-dwelling older Japanese adults

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Background and objectives: It is essential to curb or postpone the need for long-term care for older adults to extend healthy life expectancy and reduce health inequalities. If lifestyle-related habits such as proper diet and physical activity improve at the stage before the need for nursing care, such as Frailty, the impact on the prevention of the need for nursing care will be significant. This study aimed to investigate the relationship between dietary habits and frailty syndrome at baseline in the frailty prevention program for the elderly in the community.

Methods: The subjects were 182 participants of the "Itoshima Frailty Prevention Study (IFS)" who lived in Itoshima City, Fukuoka Prefecture, and were 65 years old or older (excluding those requiring support and nursing care). The number of subjects analyzed was 172 in December 2018, excluding 10 deficient frailty evaluations in the pre-intervention assessment. Evaluation items are lifestyle questionnaire (e,g. subjective health, dietary satisfaction, enjoying meals, variety of meals, frequent twice-daily consumption of meals consisting of grain, fish and meat, and vegetable dishes, eating behavior, presence/absence of co-eating). Physical frailty was measured based on five criteria proposed by Fried scale: shrinking, fatigue, low physical activity, late walking speed, and low muscle strength were classified into three groups as robust, physical pre-frailty (pre-frail), and physical frailty (frail).

Results: Among 172 participants, 50.5% of men, mean age and BMI were 72.4 years old and 23.4 kg/m^2. The percentages of frail, pre-frail, and robust were 7.0% (n=12) and 59.9% (n=103), 33.1% (n=57), respectively. Regarding meals, 85.3% of participants were satisfied with their daily meals, and 73.5% enjoyed mealtime. Furthermore, 80.0% of the participants consumed a meal that included a staple meal, main dish, and side dishes at least twice a day and at least four days a week.

Conclusion: Most participants enjoyed their mealtime and were satisfied . The percentage of older adults who eat a meal each day that includes a staple, main dish, and side dishes at least twice a day is similar to or higher than the percentage reported in the National Health and Nutrition Examination Survey.

Keyword: Frailty, Dietary, Prevention program, Grain, fish and meat, and vegetable dishes, Older adults

PAB(T3)-71
Correlations of maternal and cord blood 25-hydroxyvitamin D vary by maternal vitamin D binding protein level

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Background and objectives: *In utero,* the fetus depends on the maternal supply of vitamin D through transplacental transfer of 25-hydroxyvitamin D (25OHD). This has been confirmed by a consistently high correlation between maternal and cord 25OHD concentrations. Vitamin D binding protein (VDBP), the major

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

carrier protein of 25OHD, could be an important determinant of placental transfer of 25OHD. Maternal VDBP concentrations increase two to three folds during pregnancy but the influence of VDBP on the transplacental transfer of 25OHD has remained unexplored. Therefore, the present study aims to explore the associations and potential interactions of maternal VDBP concentrations and genotypes on the correlation of maternal and cord 25OHD.

Methods: A total of 217 mother–neonate dyads were recruited between 2015 and 2017. Plasma 25OHD concentration was measured in maternal and umbilical cord blood using ultra-high-performance liquid chromatography (UHPLC). VDBP concentrations were measured using a commercial enzyme-linked immunoassay (ELISA) kit. Maternal and cord VDBP single nucleotide polymorphisms (SNPs) (rs4588 and rs7041) were genotyped by restriction fragment length polymorphism (RFLP).

Results: A strong correlation was observed between maternal 25OHD and cord 25OHD (Spearman's rho=0.6, p<0.0001). In multivariate logistic regression, low maternal VDBP level was associated with two times higher risk of umbilical cord blood vitamin D deficiency (defined as 25OHD <30 nmol/L). No association was observed between maternal and cord VDBP genotype and cord 25OHD. This suggests that VDBP concentration but not the VDBP affinity affects the maternal-fetal transfer of 25OHD. Further analysis shows that the correlation of maternal and cord 25OHD was stronger when the VDBP level was high.

Conclusions: This study suggests the role of maternal VDBP in the transplacental transport of 25OHD. However, further studies are warranted to confirm the role of VDBP in the transplacental transport of 25OHD.

Keyword: Vitamin D, vitamin D binding protein, cord blood , 25-hydroxyvitamin D

Conflict of Interest Disclosure: No

Further Collaborators: Not applicable

PAB(T3)-72
Iron status of infants and their mothers prior to starting complementary feeding

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Background and objectives: Iron deficiency (ID) in infancy may cause irreversible cognitive deficits, in addition maternal postpartum anaemia can adversely affect the mother-infant bond and development; hence ID should be avoided during these vulnerable periods. The objectives of this research were to investigate the iron status of infants and mothers, and their relationship. To determine the differences in infant iron status according to mode of milk feeding, before commencing complementary feeding.

Methods: This study reports the baseline iron status of 133 mother-infant pairs. Healthy, term infants, 3-6 months of age (before complementary feeding), and their mothers were recruited. Haemoglobin and serum ferritin concentrations were measured to determine iron status. Demographic and feeding data was collected via questionnaires. Pearson's and Spearman's rho correlations were used to determine the relationship between maternal and infant iron status. One-way ANOVA and Kruskal-Wallis tests determined the differences in infant iron status according to mode of milk feeding.

Results: Most infants (93.2%; SF ≧10 μg/L, Hb ≧110 g/L) and mothers (80.5%; SF ≧15 μg/L, Hb ≧120 g/L) had sufficient iron stores. No infants or their mothers had iron deficiency anaemia (infant: SF <10 μg/L, Hb <110 g/L; maternal: SF <15 μg/L, Hb <120 g/L). No infants had ID (SF <10 μg/L, Hb ≧110 g/L) but 6.8% had anaemia without ID (SF ≧10 μg/L, Hb <110 g/L). One mother had ID (0.8%; SF <15 μg/L, Hb ≧120 g/L), 9.8% had mild ID (SF <30 μg/L, Hb ≧120 g/L), 7.5% had serum ferritin ≧150 μg/L indicating iron overload and 1.5% had anaemia without ID (SF ≧15 μg/L, Hb <120 g/L). There was a weak positive relationship between maternal and infant serum ferritin (r=0.19, P(two-tailed)=0.03), but no relationship between maternal and infant haemoglobin (P=0.91). There were no significant differences in serum ferritin (P=0.92) or haemoglobin (P=0.50) concentrations between milk feeding modes (breast milk vs. infant formula vs. mixed feeding).

Conclusions: Most infants and their mothers were iron-replete before starting complementary feeding and their iron stores were weakly related at 3-6 months postpartum. In addition, infant iron status did not differ by the type of milk infants received.

Keyword: Infant, Iron, Milk feeding

Conflict of Interest Disclosure: None

PAB(T3)-73
Lunch quantity (portion size) and Body Mass Index of preschool children in Japan

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Background and Objectives: Obesity is a global health problem for children, and one of the causes is overeating. It is important to acquire healthy eating habits from an early age not only to prevent obesity but also to maintain good health for a lifetime. Therefore, dietary education is necessary in kindergartens. However, children bring their lunch in a lunchbox from home and many public kindergartens in Japan do not have dietitians. Therefore, it is beneficial for non-specialist kindergarten teachers to use an index for assessing the amount of food children should consume. This study aimed to clarify the type and amount of food eaten for lunch by preschool children, and establish the relationship between the amount consumed and BMI.

Methods: This was a cross-sectional study conducted at a single center. In total, 63 children (30 and 33 in the younger [age 4–5 years] and older [age 5–6 years] classes, respectively) who

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

attended a public kindergarten in Tokyo participated in this study. Lunches in lunchboxes were weighed and photographed before and after eating. Parents of the participants indicated the household economic situation via a questionnaire. Additionally, the height, weight, and birthdate of the children were collected. These measurements and photo surveys were conducted for four days in November 2016. Based on the lunchbox weight before and after eating, we calculated the consumed weight of each meal and confirmed the contents of the lunch box from the photographs.

Results: Most lunches included rice as the major cereal. Many also included meat, fish, eggs, and vegetables. The amount of food consumed varied considerably between individuals in the younger class, and the relationship between the amount consumed by the children and their BMI was significant only in the older class and in children with normal BMI.

Conclusions: The amount of lunch consumed may be a measure of energy intake in the older class (5–6-year-old children) with normal body types. This could be attributed to most meals of preschoolers who follow a traditional Japanese dietary pattern.

Keyword: portion size, Japanese dietary pattern, lunch, kindergarten, bento

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PAB(T3)-74
The influence of availability of nutrients and bone mineral density in women training with different level

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Background and objectives: We need nutrients and adequate physical activity to develop bones and maintain bone mineral density (BMD), but there is little data on the availability of nutrients and their effects on body composition and BMD in women who train heavily on daily basis. The aim of the study was to elucidate the availability of micro- and macronutrients in women training heavily (>300min in week) in comparing not physically active women, and their BMD.

Methods: Participants completed demographic and personal behavior questionnaire (incl. IPAQ). Whole body and areal BMD were tested with dual energy X-ray absorptiometry; calcium, magnesium, vitamin D and B12 were measured from the fasting blood samples. Energy and nutrient intakes were assessed using Nutridata System. For statistical analysis continuous data and proportions were compared by t-test and Chi-square, respectively. The influences were calculated by linear regression analyses.

Results: Altogether 68 participants (mean age 36.4±7.3) were enrolled in study (equally 34 physically active and controls). Although, there were no differences in body-mass and body mass index (BMI) in two study groups, controls had higher level fat-mass (p=0.001) and fat% (p<0.001), but lower level fat-free-mass (p=0.039). Physically active women acquire from food more kcal (p=0.027), carbohydrates (p=0.048), proteins (p=0.006), but no differences in bone associated micronutrients were detected. In physically active group the vitamin B12 level in blood was higher (p=0.015) and it was influenced by the value they acquire from food (coef:6.54; p=0.032). Physical activity had no influence to the BMD. The main positive influence on BMD was fat-free-mass (total: coef 8.98e-06, p<0.001; lumbar area: coef 1.243e-05, p<0.001; femoral neck: coef 8.374e-06, p=0.004), that stayed important in multivariate analysis. In univariate analyses positive BMD and values of height, body-mass, fat-mass and fat% were detected. As food supplement consumed calcium had negative influence, and vitamin from food positive influence to BMD.

Conclusions: Physical activity in adulthood does not influence BMD, but rises fat-free-mass. Short women with small body-mass are more likely to have insufficient BMD. Micro-nutrients that affect BMD, such as calcium, should be obtained with food and not with food supplement.

Keyword: nutrition, physical activity, bone mineral density, women

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PAB(T3)-75
Locomotive syndrome risk test and lifestyle-related habits among university students

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Background and objectives: Locomotive syndrome (LS) is one of the most important health issues for older adults in Japan. Preventive measures should be initiated during childhood as 10% of children (age:7-15 years) already show signs of musculoskeletal disorders or dysfunction that may lead to LS. Many common health problems observed in Japanese young adults—such as decline in physical strength and weight issues (either underweight or obese)—are caused by the lack of exercise. The LS risk test was developed to quantify the decrease in mobility among adults. This study aimed to elucidate the association between the LS risk test and lifestyle-related habits of university students.

Methods: In 2019 and 2021, we surveyed 281 healthy students (99 men, 182 women) who consented to participate and underwent baseline assessments. We used the two-step test (TST), stand-up test (SUT), and grip strength as screening tools for LS. The K6 screening scale was used to assess mental health. A cut-off score of >=5 on the K6 scale was used to identify persons with mental stress. Data on lifestyle factors and dietary habits were obtained through a self-administered questionnaire, including a brief self-administered diet history questionnaire (BDHQ).

Results: The mean BMI of the participants was 22.9±4.2 (men) and 20.9±2.5 (women). The Advanced Glycation End-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

products (AGEs) values were 1.4±0.2 (men) and 1.5±0.2 (women). These results were below the age-specific standard for approximately 18% of men and 26% of women in the TST and for 22% of men and approximately 18% of women in the SUT. Those with below-the-standard SUT scores were less likely to exercise daily and lacked confidence in their physical strength. Approximately 18% of men and 26% of women had a K6 score of >=5. Approximately 60% of students took irregular meals, and approximately 30% reported <6 h of sleep per night. The intake of various vitamins and minerals was less than the standard value for all participants.

Conclusion: To prevent LS in the future, we recommend that university students receive counseling regarding eating habits and lifestyle practices, such as regular exercise.

Keyword: Locomotive syndrome risk test, lifestyle-related habits, university students

PAB(T3)-76
Using child growth monitoring and promotion data for decision-making in Ghana and Nepal

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Background and objectives: Health system actors can use anthropometric data collected for growth monitoring and promotion [GMP] to support individual child growth and development, as well as for program improvement. While previous studies have documented the use of GMP data for individual purposes, few studies have examined how health workers and other government officials use the data to strengthen service delivery. The objective of this study was to examine how government staff track and use GMP data for decision-making.

Methods: As part of a case study on GMP in Ghana and Nepal, we conducted semi-structured interviews with national and sub-national government officials (Ghana: 12; Nepal: 12), health workers/volunteers (Ghana: 16; Nepal: 24), and development partners (Ghana: 5; Nepal: 5) to understand GMP data collection, monitoring, and how it is used for program improvement. We coded and analyzed interview notes for themes related to data collection and use.

Results: In both countries, health workers described a systematic way to collect, document, and enter anthropometric measurements (mainly weight) taken at GMP service delivery points on paper registers and an electronic platform. Sub-national officials in both countries reported a system to review GMP program data, but noted that they did not review it as frequently as required. During monitoring visits, sub-national officials reported prioritizing data accuracy, such as through routine data quality audits in Nepal, over data use. While there were notable examples of data use for program improvement, such as health workers advocating for infant and young child feeding training in Ghana, several health workers and government officials in both countries were unaware of how to use data for decision-making other than for reporting purposes. Respondents did not describe existing guidance on how to use program data.

Conclusions: Without written guidance on how to use anthropometric data collected for GMP, health workers and their managers focused more on reporting and checking data accuracy than on using the data to strengthen service delivery. Global organizations and the governments of Ghana and Nepal should develop guidance for health workers and national/sub-national government officials on how to use GMP data for program improvement and accountability.

Keyword: growth monitoring and promotion, data for decision-making, Ghana, Nepal

Conflict of Interest Disclosure: None

PAB(T3)-77
Low carbohydrate diet and new cardiometabolic risk markers among Taiwanese children and adolescents

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Background and objectives: Low carbohydrate intake helps reduce body weight and may be associated with lower cancer risk and mortality among adults. However, the association between low carbohydrate intake and new cardiometabolic risk predictors is unclear among children and adolescents, who are in the physiological development stage.

Methods: We recruited 1739 children and adolescents (age, 7-18 years) from the Nutrition and Health Survey in Taiwan from 2013 to 2016. Carbohydrate consumption was calculated from 24-h dietary recall through face-to-face interviews. We used a low carbohydrate diet (LCD) score to indicate the percentage of energy obtained from carbohydrates; higher scores indicate lower carbohydrate intake. LCD was classified into 3 groups by tertile (T) distribution. Physical examination was conducted to obtain anthropometric measurements, and biochemical markers were quantified through laboratory analysis. Cardiometabolic risk factors were evaluated using the blood lipid profile and triglyceride/glucose index (TyG index), TyG and waist circumference (TyG-WC), TyG and body mass index (TyG-BMI), and visceral adiposity index (VAI).

Results: T2 and T3 participants in the LCD group had lower TyG index (median: 8.05, 8.08 vs. 8.12), and VAI (median: 1.7,

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DOI: 10.1159/000530786

1.67 vs. 1.78) than T1 participants. After adjustment for confounding factors, the odds ratio (OR) of T2 and T3 participants in the LCD group was 0.69 (95% CI, 0.53-0.90) and 0.75 (95% CI, 0.57-0.99) for the TyG index compared with T1 participants. TyG-WC was also inversely but not significantly associated with LCD intake in the T2 and T3 groups. Furthermore, T3 participants had a 26% (95% CI, 0.56-0.99) lower risk of high VAI than T1 participants (p for trend < 0.05).

Conclusions: Our findings demonstrated that a relatively low carbohydrate diet was linked with lower risks of cardiometabolic factors and abdominal obesity among Taiwanese children and adolescents.

Keyword: carbohydrate, cardiometabolic, children, adolescent, Taiwan

Conflict of Interest Disclosure: None

PAB(T3)-78
Oral function in adolescent female students: relationship between dietary habits and oral condition

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Background and objective: In recent years, it has been suggested that oral function is declining in adolescents. The study was conducted to understand the oral function status of adolescent female students. In addition, the dietary habits of their adolescent and schoolchild periods, as well as their current oral status, were also investigated and examined.

Methods: The study was conducted on 26 female students beginning in April 2019. The numbers of utterances of “Pa,” “Ta,” and “Ka” were measured using an oral function measuring device. The measured values were divided into two groups, the low and standard value group, referring to the measured values of healthy subjects. The survey asked about their dietary habits in their adolescent and schoolchild periods ("How many days a week do you eat breakfast?" and "Do you eat three meals a day every day?” etc.) and their current oral condition ("Are you prone to mouth ulcers?" and "Do your teeth bleed when you brush them?" etc.). It used the Mann-Whitney U test and the $\chi 2$ test for between-group comparisons.

Results: The oral function of female students, measured by the numbers of utterances of “Pa,” “Ta,” and “Ka,” differed significantly between the low and standard groups. The percentage of students in the low value group for “Pa” was high at 70%. With regard to oral function and the current dietary habits and oral condition, there was an association between the low and standard value groups for “Pa” in terms of "Do you currently have regular meal times for all three meals?," “Do you have at least 28 teeth?,” and “Do you often chew gum with xylitol?,” and for “Ta” in terms of "How many meals a week do you currently have with your family at home?"

Conclusions: The oral function of female students was suggested to be lower in terms of the number of utterances of “Pa.” Among the low and standard value groups of oral function in the numbers of utterances of “Pa” and “Ta,” an association was found between dietary habits and oral condition in the adolescent period. Therefore, dietary habits and oral condition during adolescence may be important for maintaining oral function during adolescence.

Keyword: oral function, adolescent, dietary habits, oral condition

PAB(T3)-79
Gut microbiota altered by maternal carbohydrate restriction improve obesity and associated metabolic syndrome in offspring

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Background and objectives: Maternal nutritional restriction during pregnancy is known to adversely affect glucose and lipid metabolism in offspring. We have previously found that carbohydrate restriction during late pregnancy in mice did not exacerbate high-fat diet (HFD) -induced obesity and dyslipidemia and further improved glucose metabolism in offspring. Recently, gut microbiota has been reported to be involved in host energy metabolism. Furthermore, it is demonstrated that maternal nutritional restriction causes gut dysbiosys. On the other hand, we found that maternal carbohydrate restriction significantly increased the abundance of *Prevotella*, which is reported to be involved in the improvement of glucose metabolism, in the intestine of offspring. In this study, we investigated whether transplantation of the gut microbiota of offspring altered by maternal carbohydrate restriction leads to improved glucose metabolism in recipient mice.

Methods: Eight-week-old male and female C57BL/6J mice were mated. In late pregnancy, female mice were divided into the following three groups with different nutritional restrictions: control (C), total energy restriction (R) (40% calorie restriction), or carbohydrate restriction (CHR) (40% calorie restriction by reducing only carbohydrate) group. After giving birth, each group of dams was allowed free access to a control diet and raised their own pups. After weaning at 3 weeks of age, feces were collected from pups, suspended in sterile water, and the supernatant after centrifugation was used as fecal microbiota transplantation (FMT) samples. Seven-week-old male germ-free C57BL/6N mice were administered FMT samples from either group and fed with 60%kcal HFD for 18 weeks. Mice were dissected one week after an oral glucose tolerance test.

Results: After 18 weeks of HFD intake, body weights gain, liver and some white adipose tissue weights were significantly reduced in the recipient mice administered FMT samples from the CHR group compared to C group. Food intake was significantly increased in recipient mice in R group compared to C group.

Conclusions: The results of this study showed that gut microbiota altered by maternal carbohydrate restriction could

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DOI: 10.1159/000530786

improve obesity and associated metabolic syndrome in offspring.

Keyword: gut microbiota, fecal microbiota transplantation, maternal nutritional restriction, metabolic syndrome, obesity

PAB(T3)-80
Child and paternal factors associate with a health-promoting dietary pattern in Finnish primary school-aged children

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Background and objectives: Increasing evidence suggests that specific dietary patterns may promote health. The aim of this study was to identify dietary patterns in 7–13-year-old Finnish primary school-aged children and to study associations between child and parental factors and adherence to the dietary patterns.

Methods: Families were recruited in Southwest (Turku city area) and Eastern Finland (Kuopio city area) using a random sample of the age group drawn from the Finnish Population Information System. Children filled in a five-day food diary with the help of their parents and a portion picture booklet. Dietary patterns were identified using principal component analysis. Child and parental factors were assessed with a questionnaire. Child's weight and height were measured and overweight/obesity status was defined using national growth charts.

Results: A total of 266 children (48% girls) with a mean age of 9.7±1.7 years were included in the study. Of the children, 79% had normal weight and 21% had overweight or obesity. Two dietary patterns were identified: 'healthier dietary pattern' with higher loadings of e.g. vegetables, fruits and berries, whole grain and fish and 'unhealthier dietary pattern' with higher loadings of e.g. butter and other fats, meat and high-fat dairy products. Of the children, 46% adhered to the healthier dietary pattern. Living in Kuopio area (adjusted OR 3.2 [95%CI 1.7−5.9], p<0.001) and child's male sex (adjusted OR 2.5 [95%CI 1.4−4.6], p=0.001) were associated with the adherence to the healthier dietary pattern. Furthermore, children with fathers <45 years of age (adjusted OR 2.8 [95%CI 1.5−5.2], p<0.001) and those whose fathers had university education (adjusted OR 1.8 [95%CI 1.0−3.3], p=0.047) were more likely to adhere to the healthier dietary pattern. Child's age, overweight/obesity status and maternal factors were not related to the adherence to the dietary patterns.

Conclusions: Two dietary patterns were identified among Finnish primary school-aged children. Geographical area, i.e. living in Kuopio area located in Eastern Finland, child's male sex as well as fathers younger age and university education were associated with the adherence to the healthier dietary pattern. The results may assist in understanding factors contributing to child's health-promoting eating and health in long-term.

Keyword: diet pattern, dietary intake, sociodemographic factors, primary school, children

PAB(T3)-81
Effect of prenatal multiple micronutrient supplementation during the first 1000 days of life: A review

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Background and objectives: First 1000 days of life is the period from conception to one's second birthday. This critical time frame offers an opportunity to develop lifelong health and intelligence in a child. Suboptimal micronutrient intakes during pregnancy increase the risk of poor pregnancy outcomes and may cause stunting in the first 2 years of life. Achieving optimal micronutrient intakes remain a major concern among pregnant women in low-middle income population, as they encountered multiple obstacles such as poverty, food insecurity, food accessibility as well as poor sanitation and hygiene. This review discusses the effect of prenatal multiple micronutrient supplement (MMS) versus iron-folic acid supplement (standard of care) on birth outcomes, maternal haemoglobin status during pregnancy and growth of infant up to 24 months of age.

Method: This review includes only full-text randomised controlled trials that evaluated the effect of prenatal MMS versus standard of care on the outcomes of interest, including birthweight, low birth weight, small-for-gestational age, stillbirth, preterm birth, maternal haemoglobin level, weight-for-age, length/height-for-age, weight-for-length/height, and head circumference-for-age. Eligible studies published in English were identified through electronic search of PubMed, EBSCOhost, Ovid, and Google Scholar databases.

Result: The use of MMS among pregnant mothers from the context of environment fragility and food insecurity is perceived to be strongly associated with better birth outcomes. These beneficial outcomes from MMS may have potential benefit on child's growth, however, the evidence on child's growth is limited.

Conclusion: Supplying multiple micronutrient supplement during pregnancy may provide long-term benefits on child's health and can be practical for policymakers to consider the use of MMS in pregnant women as part of existing antennal programmes. Further studies on the effect of prenatal MMS on growth of infant up to 24 months of age are recommended.

Keyword: multiple micronutrient supplement, anaemia, pregnant women, birth outcomes, first 1000 days

PAB(T3)-82

Effect of a 2-year multidomain lifestyle intervention on change in grip strength from baseline to 2 and 7 years of follow-up − The FINGER Study

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Background and objectives: Previous studies indicate an association between low muscle strength and several adverse health outcomes among older people. We aimed at assessing the effect of a 2-year multidomain lifestyle intervention to prevent muscle strength decline 2 and 7 years later.

Methods: Participants were drawn from the FINGER study, a randomized controlled trial designed for studying preventing cognitive decline in at-risk people aged 60–77 years and enrolled in 2009-2011. Participants were randomized (1:1) to a 2-year multidomain intervention (diet, exercise, cognitive training, vascular risk monitoring, n=631), or a control group (general health advice, n=629). Grip strength (kg) was measured using a hand-held dynamometer. Mixed-model repeated-measures analyses were used to assess between-group differences (group×time interaction) in the modeled changes from baseline to 2 and 7 years based on data from all participants with at least one post-baseline measurement.

Results: Information on grip strength measurement was available for 1 037 and 567 individuals at 2 and 7 years, respectively. There were no differences in participation rates of follow-up visits between intervention and control groups. Estimated mean change in grip strength at 2 years was -1.0 kg in the intervention group and -1.5 kg in the control group, and at 7 years -3.2 kg and -3.5 kg, respectively. The between group difference in change was significant at 2 years (p for group×time interaction =0.04), but not at 7 years (p=0.50).

Conclusions: Grip strength declined less in the intervention group than in the control group at 2 years, but the difference between groups was nonsignificant at 7 years. These findings suggest that a multidomain lifestyle intervention may help in alleviating the age-related decline in muscle strength, but more research is needed to assess the long-term effects of such intervention. However, even small effects on preventing the age-related decline in muscle strength might be important for maintaining functional capacity and performing activities of daily living during ageing.

Keyword: grip strength, intervention, diet, exercise, ageing

Conflict of Interest Disclosure: none

Further Collaborators: none

PAB(T3)-83

Effects of two-day prenatal methionine deficiency on pancreatic development in newborn rats

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Background and objectives: Our previous *in vitro* study showed that two-day methionine or threonine depletion reduced the number of endocrine progenitor cells and pancreatic β cells, respectively. To confirm this, we conducted an *in vivo* study using rats. Considering methionine as the main methyl donor for methylation that is important during embryogenesis, first we focused on the effect of two-day prenatal methionine deficiency (MD) on pancreatic development in newborn rats.

Methods: Male and female Wistar rats (8-week-old) were mated, and the female rat was fed with control or 86% methionine-deficient diet on day 12.5–14.5 of pregnancy, during which the endocrine progenitor cells develop in rodents. After birth, the pups were sacrificed immediately, then pancreatic development and function were investigated.

Results: Ingenuity Pathway Analysis (IPA) listed genes involved in glucose and lipid metabolism as a fluctuated gene cluster category due to prenatal MD. Interestingly, we found that prenatal MD affected newborn's pancreas function differently by gender. In male offspring, significantly lower plasma insulin levels were observed. Remarkably, although there was no significant change in the mRNA expression level of genes directly involved in insulin secretion (*Ins1*, *Ins2*, *Glut2*), there were significant changes in gene expressions related to glucose and lipid metabolism (*Fbp1*, *Rbp4*, *Gpi*, *Gapdh*, *Pparα*, *Aco2*). Moreover, a significant increase in *Ngn3* and *Nkx2.2* mRNA level expressions suggested that pancreatic β-cell differentiation was promoted to compensate the decrease in insulin secretion. This is also supported by an enhanced *Kcns* methylation, which is required for insulin secretion and is involved in the development of pancreatic β-cell. On the other hand, in female offspring, while no significant change was observed in the plasma insulin level, a tendency to decrease the mRNA expression level of *Ttr* was confirmed, suggesting that MD affected pancreatic α-cell differentiation.

Conclusions: MD during the development of endocrine progenitor cells significantly affected the embryo's pancreatic development, consequently altering the next-generation pancreatic function, which is differentiated by gender. This study presents a novel and notable nutritional perspective that even a short-term malnutrition during pregnancy is worth our attention for a better quality of the offspring's life.

Keyword: maternal nutrition, prenatal methionine deficiency, embryonic pancreatic development, glucose metabolism, insulin

Conflict of Interest Disclosure: HK is a member of the Social Cooperation Program funded by Ajinomoto Co.

PAB(T3)-84
Breastfeeding and diet of infants in the Maternal and Child Health Study of Iceland (Ice-MCH)

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Background and objectives. Combination of national health registers has given us the opportunity to construct a data set on maternal and child health variables in Iceland, Maternal and Child Health Study (Ice-MCH). The focus of the Ice-MCH is to explore the Primary Health Care and the Prescription Medicines Registers. The aim of the present abstract is to describe breastfeeding and the diet of Icelandic infants as listed in the health care system register for infants and young children.

Methods. Descriptive statistics were used on data from two reports from the medical record system Saga: "Continuation of breastfeeding" (period 15.1.2009-16.6.2015, total number of children in breastfeeding calculations n = 21,068) and "Complementary foods by age" (period 20.9. 2009-16.6.2015, total number of children in food calculations n = 36,185).

Results. At one week of age, 97% of infants received breastmilk and 82% were exclusively breastfed. At four, five and six months of age, 79%, 76% and 70% of children received breast milk and 48%, 35% and 18% of children were exclusively fed breastmilk with supplements, such as vitamin D. The proportion of children receiving vitamin D increased with age, from 82% at two months to 96% at 10 months. At the age of 10 months, fish liver oil replaced vitamin D drops as the most common source of vitamin D. When 2-months old 25% of the infants received infant formula and 33% when 3-8-months old. When 8-months old 25% got follow-on formula and 50% when 12-months old. At 10, 12 and 18 months of age, 11%, 20% and 40% of children received cow's milk. Porridge was the most common first complementary food (16% of four-month-olds, 47% of five-month-olds, 76% of six-month-olds) along with fruits / vegetables (5% of four-month-olds, 26% of five-month-olds, 65% of six-month-old). 59% and 25% of eight-months old got meat and fish, but only few six-months old did.

Conclusions. The results are in good agreement with other data on breastfeeding and diet of Icelandic infants. The Ice-MCH-Study will explore breastfeeding and diet associations to growth and drug use.

Keyword: breastfeeding, complementary foods, infancy, health data registers, childhood

Conflict of Interest Disclosure: No conflict of interest

PAB(T3)-85
Availability of global adolescent's dietary intake data: a scoping review

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Background and objectives: Dietary intake during adolescence is of crucial importance to nutrition, growth, and future health outcomes. However, the availability of (high quality) data on adolescent's dietary intake are scarce with great global differences. We sought to provide an overview of available most recent adolescent's dietary intake data and their quality and identify countries and regions with evidence gaps.

Methods: We conducted a scoping review (in February 2020, updated in December 2021) including articles published in the academic and grey literature from 2010 onwards. Studies from all countries and languages including any sub-set of adolescent boys and girls between 10-24 years of age and including any information related to types of food consumed, diet composition, dietary diversity, or meal patterns were considered. We excluded studies with insufficient methodological information or unclear description of population, samples sizes below 25, school-based data sets set in less than six schools, and studies with unhealthy study population.

Results: A total of 32,102 titles were located from the literature search and 753 articles are retained and currently analysed. About one third of the articles stem from the grey-literature search. While some dietary data were found for 154 (62%) of all 249 countries, preliminary findings suggest that nationally representative, detailed dietary data were only available for a small share of mainly high-income countries, predominantly in the Americas, Europe, or Asia. Most of all studies displayed data that could not be further disaggregated by sex or location (urban vs. rural).

Conclusions: The preliminary findings of the review highlight that nationally representative adolescent's dietary intake data are still scarce, especially given the fact that a substantial share of data are only available as grey literature. For most of the countries, where data are available, granularity of the data does not permit a meaningfully characterization of dietary patterns among subgroups. Furthermore, representative data are particularly scarce in some world regions, most notably Africa. While further analysis will provide more detailed insights the preliminary findings emphasize the need for more representative, detailed, and granular data to understand global and regional data gaps and ultimately address adolescent's diet quality.

Keyword: Dietary intake, Food consumption, Adolescents, Young adults, Review

PAB(T3)-86
Association of child hemoglobin across the first 2y of life with child cognition at 6y

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Background/Objectives: Anemia in early childhood is associated with poor intellectual functioning but less is known about the significance of changes in hemoglobin (Hb) during the first two years of life for child health and development. We examined the associations between child Hb trajectories and cognitive functioning at age 6y (Wechsler Intelligence Scale for Children).

Methods: We used data from a micronutrient supplementation randomized controlled trial (PRECONCEPT) conducted in Vietnam. We analyzed data for 648 mother-infant pairs with child Hb values at 3 mo, 6 mo, 12 mo and 24 mo and cognition at 6y. Multivariable linear regression models were used to assess the association between Hb trajectories and five measures of cognitive functioning, adjusting for maternal (age, education, depression, intervention group), child (sex) and household (socioeconomic status, home environment) characteristics.

Results: Four distinct child Hb trajectories were identified. Track 1 (2%): mean child Hb concentrations were 6.6 g/dL at 3 mo but between 10-11 g/dl thereafter. Track 2 (49%): mean child Hb concentrations were 10.1 g/dl at 3 months and remained between 10-11 g/dl thereafter. Track 3 (7%): mean child Hb concentrations were 9.9 g/dl at 3 months , 8.2 g/dl at 1y and 10.5 g/dL at 2y. Track 4 (42%): children had mean Hb concentrations >10.5 g/dl throughout the first 2y of life. Compared to children in track 2, those in track 3 had lower perceptual reasoning index (-3.96; 95% CI:-8.12-0.21), whereas track 1 children had higher processing speed index (6.24; 95% CI:1.02-11.45). Child Hb trajectories were not associated with full-scale intelligence quotient at 6 years.

Conclusions: Child hemoglobin trajectories across the first two years of life had weak associations with child cognition at age 6 years. Declines in child Hb were associated with lower cognitive scores while children whose Hb increased during first two years of life had higher cognitive scores. Further research is needed understand to examine the utility of monitoring hemoglobin values in young children.

Keyword: hemoglobin, child, cognition

Funding Sources: NIH (1R03HD102513-01), Nestle Foundation, Micronutrient Initiative, Mathile Institute for Advancement of Human Nutrition

Conflict of Interest Disclosure: None

PAB(T3)-87
Assocition between dietary patterns and cognitive change: A systematic review

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Background and objectives: Currently the role of diet in relation to brain ageing is unclear. Analyses of dietary patterns (DP) may improve our understanding of this potential relationship. This review aimed to investigate potential relationships between DPs and measures of cognitive change. Data presented are part of a broader systematic review exploring the role of DPs in brain ageing.

Methods: Protocol was registered with PROSPERO(CRD42020181423). EMBASE and MEDLINE databases were used to search for studies up to March 2020. Eligible studies were published in English, were prospective, and examined DPs in relation to cognitive change in adults, measured via neuropsychological tests conducted at >1 time point. The Newcastle-Ottawa Scale (NOS) was used to assess risk of bias. Meta-analysis was not performed due to heterogeneity between studies, particularly in measures of diet and cognition.

Results: From 9216 articles screened, 41 studies met inclusion criteria. Sample sizes ranged from 70 to 27860 and follow-up periods ranged from 1 to 24.8 years. Two thirds (N = 28) of studies were conducted in middle-aged to older adults (51-74 years), six in very old adults (≧75 years), two in young adults (36-50 years) and five were mixed age. Populations spanned globally, however nearly half (N = 20) were from North America. DPs derived a-priori were analysed most frequently (N = 28), with the Mediterranean DP (MeDi) studied the most often (N = 22). Eight studies used a-posteriori methodology to derive DPs and five studies used both a-priori and a-posteriori. Overall, from 41 studies, 15 (37%) found a beneficial association of DP on cognitive change, 16 (39%) found no association, eight (19%) found mixed associations (often due to different DPs studied) and two (5%) found a negative association. Five studies were rated as low quality on the NOS, 28 as medium and 8 as high.

Conclusions: The review found the MeDi was the DP explored most frequently. Although findings were not consistent, they suggested the MeDi may preserve cognition during ageing. However, evidence for the influence of other DPs was unclear. Future research should investigate DPs other than the MeDi, especially within non-Mediterranean populations, to help determine their impact on brain ageing.

Keyword: Cognition, Systematic Review, Dietary Patterns, Brain Health

Conflict of Interest Disclosure: No disclosures to declare.

PAB(T3)-88
Ultra-processed food and semen quality in men

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Background and objectives: Moderate grade of food processing may be beneficial to the bioavailability of nutrients, but extreme processing and additives used to improve storage stability may be detrimental to health. The quality of male sperm, which is sensitive to external factors, may be negatively affected by a diet based on ultra-processed foods (UPF). Thus, the aim of the study was to determine the association between UPF intake and the semen quality parameters of men.

Methods: This cross-sectional study was carried out in 208 men aged 18-53 years from Northern-Eastern Poland. Semen samples were collected at the clinic. Semen microscopic measurements were determined with the use of computer-aided semen analysis (CASA). Dietary data were obtained using a validated frequency questionnaire. The extent of food processing was categorised according to the NOVA classification. The NOVA groups were calculated as an isoenergetic share of the food group. The association between NOVA groups and semen parameters were analysed with an adjusted linear regression model.

Results: In the analysis we include 168 men with median age of 26.0 years and BMI of 24.8 kg/m2 (IQR 22.9-26.8 kg/m2). Based on the NOVA classification, we can indicate that the diet of the subjects consisted of 46.1% non- and minimally processed food (NPF), 2.3% culinary ingredients (CI), 21.3% processed food (PF) and 29.8% UPF. The results of the analysis of the association of NOVA classification with semen quality parameters showed a negative relationship of CI with progressive and total motility (β=-3.0; 95%CI: -5.3,-0.63 and β=-4.0; 95%CI: -6.8, -1.3). PF were positively associated with sperm count (β=35.0; 95%CI: 2.9, 67) and morphology (β=0.93; 95%CI: 0.03, 1.8). No association of UPF with semen quality parameters was shown.

Conclusions: Our results suggest that higher consumption of culinary ingredients may negatively affect progressive and total sperm motility and processed food may be positively related to sperm count and morphology. Furthermore, our results did not present an association between ultra-processed food with semen quality parameters.

Project financially supported by Minister of Education and Science in the range of the program entitled "Regional Initiative of Excellence" for the years 2019-2022, Project No. 010/RID/2018/19.

Keyword: diet, processed food, dietary patterns, fertility

PAB(T3)-89
Dyslipidemia, hyperglycemia, hypertension and obesity as biomarkers of metabolic syndrome among pregnant women in non-urbanized Ghana

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Background and objectives: Metabolic syndrome (MetS) is a multifactorial comorbid disease heightened in pregnancy by the hormone-regulated state that stimulates inflammation, metabolic disturbance and chronic stress. Among pregnant populations residing in non-urbanized settings, the epidemiologic linkages between the component syndromic disorders are not established. Our aim was to determine the co-occurrence, associated maternal socio-medical factors and the outstanding correlates of MetS.

Methods: We prospectively followed a cohort of 454 women attending peri-urban and rural healthcare facilities in Ghana from trimester one to six weeks postpartum. After obtaining socio-demographic and anthropometric data in the first trimester, participants were scheduled for fasting plasma lipid panel and glucose testing in the second trimester while pregnancy weight gain, blood pressure and proteinuria were assessed throughout gestation. Concurrent presence of three or more biomarkers containing dyslipidemia, hyperglycemia, hypertension or adiposity was diagnosed as MetS. Analyzing in Stata, we used unordered multinomial regression to identify interactions between socio-medical factors and metabolic biomarkers, adjusting for covariates and weighting for non-response.

Results: MetS was 2.20% . Dyslipidemia (53.35%) was the most prevalent MetS biomarker manifesting as elevated triglycerides (20.98%), total cholesterol (4.68%), low high density lipoprotein (38.31%) and low density lipoprotein (4.45%), followed by hyperglycemia (15.19%) resulting from elevated fasting glucose (11.03%) and 2-hour oral glucose tolerance test (8.77%) alongside pre-existing diabetes (7.05%). Of the 13.41% adiposity cases, 11.75% were obese and 7.01% had upper-arm circumference above 35cm. Chronic hypertension (3.74%) and pregnancy-induced hypertension (2.86%) were the least prevalent. Maternal age 20-24 years (RR:0.18, 95% CI:0.05-0.65) and peri-urban residency (RR:2.08, 95%CI:1.02-4.24) independently interacted with at least one abnormal MetS biomarker but not with MetS per se. Hypercholesterolemia (r=0.652), obesity (r=0.515) and pre-prandial glucose (r=0.507) were the moderately strong correlates of MetS.

Conclusions: In line with the epidemiological transition, we see higher risk of MetS among urbanized dwellers. Dyslipidemia resulting from hypertriglyceridemia and hypercholesterolemia were most common, affecting 20-40% of the population, but the latter was the strongest MetS correlate. Meanwhile, in Ghana, lipid profiling is requested only during cardiovascular emergencies. Awareness of its risk of triggering long-term health

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

events and advocacy on routine lipid testing and nutritional preventive strategies are crucial.

Keyword: Pregnancy, Metabolic Syndrome, Blood Lipids, Blood Glucose, Blood Pressure

Conflict of Interest Disclosure: None

PAB(T3)-90
Knowledge of preconception care among in-school adolescents in two local government areas of Kano state

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Background and objectives: Preconception care acknowledges that many adolescent girls and young women will be pushed into motherhood lacking the knowledge, skills or support needed for optimum health outcomes. While studies exist on knowledge of preconception care among women of reproductive age and health practitioners in Nigeria, very few focus on adolescents and not much has been published about the unique case of the northern region. The aim of this study was to determine the level of knowledge of preconception care among in-school adolescents in selected local government areas in Kano state.

Methods: This study was a descriptive cross-sectional study which utilized quantitative methods of data collection. The study population comprised of in-school adolescents of selected secondary schools within the local government areas with sample size of 410. A pre-tested semi-structured self-administered questionnaire was used to collect the data on reproductive health risk factors, exposure to reproductive health information and pregnancy prevention and contraception. Data was analysed using descriptive statistics and inferential statistics at $p<0.05$ with the aid of Statistical Package for Social Sciences version 22.0.

Results: Respondents' ages ranged between 15 years to 18 years and 33.9% (134) were 18 years with a mean age of 16.83±1.05. The findings from this study showed that 8.9%. 77.5% and 13.7% of the respondents had poor, average and good knowledge respectively. The mean score for the level of knowledge was 8.7±2.4. From the study, a statistically significant association was found between respondents' gender, having had a family member that experienced complications during pregnancy and having had a close friend or relative since they were 12 years of age, get pregnant, with knowledge of preconception care as $p<0.05$.

Conclusions: Majority of the respondents had average knowledge of preconception care. Based on these findings, there is need to employ a holistic approach to further improve knowledge. Preconception care, adolescent and sexuality education should be incorporated into the school curriculum putting into consideration the cultural disposition of the northern region. This will aid cultural acceptance and an effective intervention regarding preconception care among this target population.

Keyword: Sexuality education, Early marriage, Preconception care, Adolescents, Reproductive health

PAB(T3)-91
Strengthening nutrition interventions during antenatal care improved maternal dietary diversity and consumption of iron-folic acid supplements in Ethiopia

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Background and objectives: The importance of integrating maternal nutrition interventions in antenatal care (ANC) to improve maternal and child health is widely recognized. In Ethiopia, the coverage and quality of maternal nutrition interventions remains low, despite their adoption into national guidelines. We tested the impact of a package of counseling interventions delivered through government health facilities and community platforms and implemented by Alive & Thrive (A&T) on maternal dietary diversity, iron-folic acid (IFA) consumption, and early breastfeeding practices.

Methods: We used a cluster-randomized trial design, comparing 15 health center catchment areas in A&T intervention areas to 15 in control areas in the SNNP and Somali regions. We surveyed 540 pregnant women and 1,889 recently delivered women in July-September 2021, following a year of program implementation. We used linear regression models, adjusted for geographical clustering, to test for differences in maternal dietary diversity, IFA consumption, and early breastfeeding practices between groups. In adjusted models, we controlled for gestational or maternal age, cesarean section, child age and sex, household food security and wealth, and region.

Results: Pregnant women in A&T areas consumed 0.6 more food groups and had 1.9 higher odds of achieving minimum diet diversity than women in control areas. Women in A&T areas consumed a significantly larger number of IFA tablets during pregnancy (35 tablets) than control areas at endline, with improvements in consumption of 90+ and 180+ IFA tablets. There were no significant impacts on both early initiation of breastfeeding and exclusive breastfeeding in the last 24 hours, or number of ANC visits during pregnancy. There was significantly higher exposure to maternal nutrition and breastfeeding counseling during ANC in A&T areas at endline; however, exposure was also >50% in control areas.

Conclusions: Despite interruptions to implementation due to the COVID-19 pandemic, strengthening the delivery of maternal nutrition interventions delivered through government ANC services were effective in improving maternal nutrition

practices. Impacts and differences between groups may have been attenuated, as there appeared to be substantial spillover in control areas.

Keyword: antenatal care, maternal nutrition, nutrition interventions, Ethiopia

Conflict of Interest Disclosure: Authors have no conflicts of interest

PAB(T3)-92
Trends and determinants of the double burden of malnutrition among adolescent girls in Nairobi slums in Kenya: Findings from a cohort study 2017-2019

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Background and objectives: Rapid and unplanned urbanization in low and middle-income countries (LMICs) has led to nutrition transition and burgeoning of urban slums characterised by abject poverty and high rates of food insecurity, which are linked to the double burden of malnutrition (DBM). We examined the trends and determinants of DBM, among adolescent girls living in the urban slums of Nairobi in Kenya.

Methods: A prospective cohort of 494 adolescent girls was followed for three years (2017-2019). Anthropometric, socio-demographic and mental health (adverse experiences and depressive symptoms) data were collected once in each year. Indicators of over nutrition (overweight and obesity) and undernutrition (stunting and thinness) were computed from BMI for age and BMI for height Z-scores. Change from normal nutrition at recruitment to either overweight/ obesity or stunting/ wasting during follow-up was defined as 'transition to overnutrition' or undernutrition respectively. Multiple mixed effects logistic regression, with random effects at the individual level was used to establish the determinants of the transition to over or under nutrition.

Results: At baseline, prevalence of overweight/obesity was 12% stunting 9% and thinness 9%. During the follow-up period, overweight / obesity and stunting increased by 5% and 2% respectively, while thinness reduced by 4%. Adolescents whose mothers were employed had lower odds of transitioning to overweight/obesity compared to those whose mothers were not employed (OR 0.197, CI, 0.04 to 0.92), while those who perceived their neighbourhood as safe had lower odds of transitioning to stunting, compared to those who perceived their neighbourhood as unsafe (OR 0.35, 95% CI 0.12 to 0.97).

Conclusions: The findings depict a growing burden of overweight/ obesity, alongside stunting in urban slums. Multisectorol and nutrition sensitive interventions to prevent transition to both undernutrition and overweight should consider targeting women empowerment through education and employment opportunities and improving the safety of neighbourhoods, as a strategy to curb double burden of malnutrition in adolescents, especially in low income communities.

Keyword: Adolescents, Double burden of malnutrition, Nutrition, Urban slums

Conflict of Interest Disclosure: Authors declare no conflict of interest

PAB(T3)-93
Association between defecation status and energy intake during breakfast, lunch, and dinner among university students—a cross-sectional study

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Purpose: Constipation is a relatively common physical symptom, especially among young women. Studies of university students have shown that skipping breakfast and irregular meal times were associated with constipation. However, few studies have examined the association between the amounts consumed during breakfast, lunch, and dinner and constipation. Therefore, we aimed to estimate the association between defecation status and energy and nutrient intake during breakfast, lunch, and dinner among university students.

Methods: This study was conducted annually from May 2018 to June 2021 among university students using a 19-item questionnaire, including defecation status, physical activity, lifestyle, and fluid intake, and an 82-item semiquantitative food frequency questionnaire. The 461 university students (74 males and 387 females) were divided into two groups according to defecation frequency: a regular stool group (R): 285 students (63 males and 222 females), who defecated at least 5 times per week, and a tend-to-be-constipated group (T): 176 students (11 males and 165 females) who defecated 4 times per week or less. Considering the distribution, the t-test and Welch's test were used for comparison between groups. IBM SPSS Statistics 24 for Windows was used for analysis ($p<0.05$).

Results: In the females, the energy intake during breakfast, lunch, and dinner was significantly lower in the T group than in the R group. In the males, there was no significant difference between the energy intake at each meal; however, there was a weak negative correlation between the breakfast energy intake and frequency of defecation. Among the females, the T group had significantly lower carbohydrate, protein, and fat intake than the R group, whereas no significant difference was observed in the males.

Conclusion: These results suggest that there is an association between the defecation status and the energy intake during breakfast, lunch, and dinner among female university students, which may be influenced by a deficiency of the three major nutrients that provide energy. Among the male university students, breakfast intake may be associated with the defecation status.

Keyword: Defecation

PAB(T3)-94

Determinants of low minimum dietary diversity among Syrian refugee children aged 6 to 23 months living in Greater Beirut, Lebanon including the perspectives of mothers and health staff

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Background and objectives: Worldwide, nearly 3 out of 4 children aged 6 to 23 months are not achieving a minimum diversity in their diet putting them at risk of malnutrition. Syrian refugees living in a challenging food environment face socio-economic barriers to an adequate nutrition of their offspring. The objectives of the study were (1) to specify the determinants of two minimum dietary diversity (MDD) indicators and (2) to elucidate the knowledge, attitudes and perceptions (KAP) of mothers and health staff towards young child nutrition.

Methods: A cross-sectional survey using a mixed-methods approach was conducted at primary health care centers in Greater Beirut, Lebanon from July-October 2018. Quantitative 24 hours dietary recall data and hemoglobin levels were collected from 215 Syrian children aged 6 to 23 months and their mothers. Multivariate logistic regression analyses using minimum dietary diversity indicators (MDD7: 4 out of 7 food groups, MDD8: 5 out of 8 food groups including breastmilk) as outcome variables and thematic analyses of qualitative data were performed.

Results: The Syrian families had on average 2.5 (± 1.5) children and 6.3 (± 2.9) family members. The prevalence of children achieving a minimum dietary diversity was low while anemia was high (MDD7: 42.2%, MDD8: 33.0%, anemia: 42.1%). MDD7 and MDD8 were positively associated with the age of the child, the number of times the child ate foods and the mother consumed snacks. The odds of a child achieving a MDD7 was 8.4 (95%CI: 2.9-24.6) and a MDD8 was 4.8 (95%CI: 1.9-11.7) times higher when the mother achieved a minimum dietary diversity (MDD-W) as when she did not. Both MDD indicators were not associated with anemia, anthropometric and socio-economic variables. The KAP of Syrian refugee mothers on nutrition varied greatly, whereas the Lebanese health staff attached great importance to dietary diversity and adequate complementary feeding: "*First, we direct them to nutrition, to food, the most important thing is nutritious food*." *(Nurse)*

Conclusions: The child's dietary diversity is linked to maternal dietary diversity. Improving the KAP of Syrian mothers on good nutrition through health staff might be a pathway to improve the young children's diet.

Keyword: dietary diversity, young children, nutrition, KAP, refugees

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T3)-95

The effect of infant feeding on infant development: A longitudinal study, on healthy term babies at a tertiary care hospital in Colombo, Sri Lanka

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Background: Sri Lanka was awarded green status for breastfeeding in 2020. Breastfeeding results in better cognitive development. This is the first Sri Lankan study to describe the association between infant feeding and development.

Objective: To determine if infants fed according to Infant and Young Child Feeding (IYCF) guidelines, have higher Bayley III Development scores compared to those who are not.

Methodology: Descriptive longitudinal study, 2015-2019, at Professorial Unit, De Soysa Hospital for Women. Healthy, term babies born to mothers, >18years of age, who agreed to attend monthly follow-up were enrolled. Single trained assessor used Bayley III at 3,6,9,12,18 and 24 months of age. All IYCF indicators were taken as per definition given in IYCF 2021 guidelines. Data was collected monthly and two-monthly during the first and second year via 24-hour dietary recall and interviewer administered questionnaire. An IYCF score was calculated by awarding a point for adhering to each IYCF indicator. Independent sample t-test and simple linear regression was used for statistical analysis (SPSSv27). Ethics approval was obtained from Faculty of Medicine, University of Colombo.

Results: A total of 723 Bayley III assessments were carried out. At 24 months of age, infants with minimal meal frequency had higher cognitive scores [scaled(10 vs8, p= 0.003), composite scores(99 vs 90, p=0.003)], children who did not consume salt had higher social emotional score [scaled(18 vs 17, p<0.001) composite(140 vs 134, p<0.001)], infants who were not bottle fed had higher receptive language scores [raw (27 vs 23, p=0.004), scaled (10 vs 8, p=0.01) and growth score (592 vs 563, p=0.008)], language scores [scaled(19 vs13, p=0.006), composite (97 vs 88, p=0.018)] and motor scores(17 vs 13, p=0.019). Babies who were exclusively breastfed for 6 months had higher scaled scores for language (p<0.001) as well as motor (p<0.001) domains. Each unit increase in IYCF score increased cognitive, language and motor scaled scores by 0.5, 2.285 and 2.064 respectively. Each month of exclusive breastfeeding increased language, motor and general adaptive scaled scores by 2.12, 1.93 and 8.5 respectively.

Conclusion: Adherence to IYCF guidelines results in higher Bayley III scores for cognitive, language, motor and social emotional development.

Keyword: Infant and Young Child Feeding, Infant development, Sri Lanka, Bayley III Scores, Breastfeeding

Conflict of Interest Disclosure: None

PAB(T3)-96

Growth faltering during first 18 months of life in a cohort of children in an urban area of Sri Lanka and the associated feeding practices

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Background and objectives: Faltering in physical growth in exclusively breastfed infants is commonly seen during 4 - 6 months of age in Sri Lanka. This study was designed to assess pattern and timing of growth faltering and its association with the feeding practices in children up-to 18 months of age.

Methods: A cross sectional descriptive study was conducted in 254 children aged 12 and 18 months attending an immunization clinic. Weight and length were measured using standard methods and data on previous growth were extracted from the Child Health Development Record. Feeding practices were assessed using interviewer-administered questionnaire. A drop of >0.25 in weight-for-age Standard Deviation Score (SDS) from birth SDS was defined as weight faltering.

Results: Study population included 53.1% (n=135) of 12-month-olds and 44.5% (n=113) were females. Weight-for-age SDS <-2SD was seen in 19.3% (n=49) and length-for-age SDS <-2SD in 10.2% (n=26) at 12 and 18 months of age. Weight-for-length SDS <-2SD was seen in 17.7% (n=45), and 22.2% of them were <-3SD. Weight faltering occurred at some point in 64.2% (n=163) during first 18 months of life, and 78.5% of whom, had the onset ≦4 months of age. Majority (76.6%, n=98) with weight for age faltering by 4 months remained weight faltered at 12 months (p=0.497), while 29.7% (n=38) had a weight-for-length <-2SD (p<0.001). Prevalence of weight faltering was 50.4%, 46.1%, 48.4% and 48% at 4, 6, 9 and 12 months respectively. Exclusive breastfeeding was given at least until 4 months in 88% (n=223) and up to 6 months in 60% (n=153) while 92.9% (n=236) were breastfed at 12 months, with 38.2% (n=97) were breastfed on demand after six months. Complementary feeding was started before 6 months in 40.6% (n=52) with early weight faltering, but only 20.3% received it with proper consistency. Breastfeeding throughout the night was significantly associated with current weight-for-length being <-1SD (OR=1.89, CI, 1.04 - 3.45; p=0.037).

Conclusions: Early growth faltering was found in this population with high exclusive breastfeeding rates and persisting growth faltering was associated with poor feeding practices. Therefore, timely individualized interventions need to be taken to improve long term growth.

Keyword: growth faltering, breastfeeding, complementary feeding

PAB(T3)-97

Breakfast habits of newly enrolled women's university students and related factors in a Japanese registered dietitian training school

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Background and objectives: T University students lack knowledge about lifestyle-related diseases and do not acquire appropriate health behaviors. This study aimed to analyze the relationship of consciousness of eating breakfast and related factors among university freshwomen.

Methods: For 141 freshwomen, physical fitness measurement (height, weight, standing trunk flexion, grip strength, sit-ups, side-step test and 20-m shuttle run test) and questionnaire survey (eating breakfast, exercise and sleep habit) were conducted.

Results: Full dataset was obtained from 116 students. The results showed that the percentages with consciousness of eating breakfast were 79.3%. The percentages with good sleep more than 6 days a week were 48.3%. On the other hand, the percentages of those who engaged exercise or sports activity were 6.9%. By comparing with and without eating breakfast habit, it was clear that the group with eating breakfast habit had high total score in physical fitness than the group without eating breakfast habit. By logistic regression analysis, the factors related consciousness of eating breakfast were total score in physical fitness (odds ratio; OR = 0.922, 95% confidence intervals; CI: 0.856, 0.992) and side-step test score (OR = 0.752, 95%CI: 0.566, 1.000).

Conclusions: From the results, physical fitness practices should be also considered for improving breakfast habit. This showed that university freshwomen in the Japanese registered dietitian training school did not do exercise practice although they had consciousness of eating breakfast.

Keyword: university freshwomen, eating breakfast habit, exercise habit, sleep habit, physical fitness

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-98

Protein restriction during the fetal period upregulates IL1B and IL13 while suppressing MUC2 expression in the jejunum of mice after weaning

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Background and objectives: Several recent studies have suggested that malnutrition during developmental periods affects organ function, including that of the small intestine, after birth. However, it is unclear whether carbohydrate or protein restriction during pregnancy affects the expression of mucins and cytokines within the small intestine.

Methods: We examined mRNA and protein expression of cytokines and a mucin *Muc2* by qRT-PCR and western blot, respectively, in the jejunoileum of 28- and 46-day-old mice born from mothers fed a low-carbohydrate (LC) or low-protein (LP) diet compared with those born from mothers fed a control (AIN-93G) diet during pregnancy.

Results: The mRNA and protein expression of *Il1b* and *Il13* in the jejunum in 28-day-old mice was higher in the LP group. *Il1b* mRNA expression in the jejunum in 46-day-old mice was higher in the LC and LP groups than in controls. However, the mRNA and protein expression of *Il18* in the jejunum in 28-day-old mice was no difference between the LC or LP groups and controls.The protein levels of MUC2 in 46-day-old mice were lower in the LP group than in the control group.

Conclusions: Fetal protein restriction in mice disrupts jejunal immune-and barrier function-related expression after weaning.

Keyword: IL1B, IL13, MUC2, fetal malnutrition, jejunum

PAB(T3)-99

Nutritional perceptions, practices, and priorities of women during and outside pregnancy in Kisosonkole zone in urban central Uganda

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Background and objectives: The nutritional practices of women in their life course and particularly during pregnancy are associated with maternal and child health outcomes. This study aimed to establish the prevalent perceptions, practices, and priorities of eating during and outside pregnancy, among women in the Kisosonkole zone, in urban central Uganda.

Methods: The study adopted a mixed-method design. It included 80 women; 20 pregnant women and 60 women who had given birth during the last five years, ages 25-35. The selection of the participants in the study was done by non-probabilistic sampling with a margin error/ confidence interval of 0.1, using the formula; error = 1/√N. Data was collected using semi-structured interviews and analyzed both descriptively and theoretically.

Results: The average number of children was 2-3 (SD=0.7). The average number of pregnancies that were not carried to full term was 1 (SD=1.1). 23% of the women reported experiencing problems during pregnancy, the commonest problem was weakness. Fruits and vegetables, and variety were commonly perceived as necessary. Alcohol and fatty foods were perceived as harmful. However, most women commonly ate foods from only one food group in a day and most women reported that they did not change their eating habits during pregnancy. When the women changed their eating habits during pregnancy, they predominantly increased their intake of high energy staples, but not their intake of high protein foods or micronutrient-rich fruits and vegetables. The most common concerns that inspired dietary modifications during pregnancy were strength, the health of the baby, the risk of having a big baby and needing a c-section delivery, and painless delivery.

Conclusions: Despite the knowledge that fruits and vegetables, and variety are beneficial for pregnancy, women did not modify their diets to achieve this, likely due to the high cost associated with it. Furthermore, the recurrent concerns of women during pregnancy were the health of mother and baby, and the ease of pregnancy and childbirth. Addressing the food accessibility issues of women and strengthening nutrition education on how to improve the health of mother and child, and minimize complications continues to be imperative.

Keyword: Infant health, Maternal health, Childbirth, Food access, Nutrition education

Conflict of Interest Disclosure: None

PAB(T3)-100

Nutritional status and iodized salt use among school-aged children living in Phu Kut city, Xieng Khouang province, Lao PDR

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Background and objectives: Iodine deficiency (ID) in school-aged children (SAC) remains a public health problem worldwide. ID is the leading cause of growth retardation and delayed cognitive development. Presently, there is a scarcity of surveillance data of nutritional status and iodine deficiency among SAC in Lao PDR. Therefore, this study aimed to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

investigate the nutritional status and iodized salt use of SAC living in Phu Kut city, Xieng Khouang province.

Methods: General information including seafood consumption were interviewed using questionnaire. Weight and height of SAC were measured using a standard procedure. Nutritional status were classified based on the WHO growth reference data for 5-19 years. A sample of salt consumed in the child's household was obtained and iodine content was analyzed using iodometric titration technique.

Results: Three hundred and sixty seven SAC with mean aged of 7.8 ± 1.5 years participated in the study. More than half (54.8%) of children were males and about 41% were the first child of family. Only 25% of the populations consumed seafood in the past week. Mean weight and height were 23.2 ± 5.4 kilogram and 121.5 ± 9.6 centimeter, respectively. Mean z-score of height for age (HAZ), weight for age (WAZ) and BMI for age (BAZ) were -1.2 ± 1.1, -0.9 ± 1.0, and -0.3 ± 1.0, respectively. Using the WHO cutoffs, 23.2% and 16.3% of children were classified as stunting and underweight. On the other hand, 3.8% and 9.5% of children were classified as thinness and overweight/obesity. In addition, 85.9% of salt samples from the households contained less 20 ppm of iodine, indicating low iodine in salt.

Conclusions: School-aged children living in Phu Kut city, Xieng Khouang province are facing with several nutritional problems. Furthermore, the coverage of using adequately iodized salt is extremely low. Therefore, quality assurance of iodized salt production and ID surveillance program in SAC and other vulnerable populations are urgently needed.

Keyword: school-aged children, nutritional status, iodized salt, iodine deficiency, stunting

Conflict of Interest Disclosure: The authors declare no conflict of interest

Further Collaborators: None

PAB(T3)-101
Determinants of early initiation of breastfeeding among postpartum mothers in the Tamale metropolis, Ghana

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Background and objectives: Early initiation of breastfeeding which is breastfeeding within the first hour after birth is highly recommended to promote the establishment of breastfeeding, and consequently survival and proper growth of a child. However, the prevalence of early initiation of breastfeeding in Tamale Metropolis keeps declining. Therefore, the aim of this study was to identify the determinants of early initiation of breastfeeding in the Tamale metropolis.

Methods: A retrospective cross-sectional study design entailing a consecutive sampling technique was used to select 370 mothers with their infant pairs aged 0-6 months attending child welfare clinics at the Tamale Central and West Hospitals, Tamale Reproductive Child Health Unit and the Tamale Teaching hospital in Ghana. Pearson Chi-square and binary logistic regression analyses in Stata aided to find associations and to establish the adjusted odds ratio (AOR) of delayed breastfeeding initiation.

Results: Prevalence of early initiation of breastfeeding was 77.8%. Mothers who had primary and secondary education were 82% (AOR=0.126, 95% CI:0.04-0.38, p=<0.0001) and 62% (AOR=0.381, 95% CI:0.19-0.76, p=0.006) less likely to delay breastfeeding initiation when compared to those without formal education. Although regularity of antenatal care visits did not show any significant association, mothers not counseled on breastfeeding initiation during prenatal care (AOR=4.1, 95% CI:2.18-7.69, p<0.0001) nor had knowledge on the benefits of early initiation of breastfeeding (AOR=2.23, 95% CI:1.29-3.86, p=0.004) were more likely to delay breastfeeding initiation. However, women whose spouses had secondary (AOR=5.70, 95% CI:2.05-15.84, p=0.001) and tertiary education (AOR=4.32, 95% CI:1.53-12.21, p=0.006) were 4-6 times more likely to delay breastfeeding initiation. Health-related correlates that significantly delayed breastfeeding initiation included birthing in private facilities (AOR=6.6).

Conclusion: Both socio-demographic and health-related drivers such as maternal education, counselling on early initiation and knowledge on the benefits of early initiation were protective of early initiation while delivery facility and spouse education delayed initiation. In order to enhance timely breastfeeding initiation, education on the importance and benefits of early breastfeeding initiation needs strengthening during prenatal care, with spouses actively involved in the process. Private healthcare providers require supervision to implement and promote baby friendly birthing practices.

Keyword: Early Initiation of Breastfeeding, Tamale Metropolis, Association, Determinants

Conflict of Interest Disclosure: On behalf all authors I declare that we do not have competing interest

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PAB(T3)-102
Changing health and nutrition behaviour to address stunting through peer support and community action: A Case Study of the First 1,000 Days Program in Vanuatu.

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Background and objectives: Globally, chronic malnutrition, which is evident by stunting, has declined steadily since 2000 – but faster progress is needed to reach the 2030 Social Development Goals target. According to the 2021 Global Nutrition Report, stunting rates in Vanuatu increased from 25.7% to 28.9% between 2008 and 2013 and the prevalence of anemia among women of reproductive age increased from 24% in 2010 to 25% in 2016. Further research has shown that stunting

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

occurs in-utero hence interventions to address stunting are targeted at the first I,000 days window. Save the Children (SC) implemented the ***First 1,000 Days Program*** in Vanuatu across 22 communities in Shefa and Sanma Provinces between 2017-2021 with the aim of contributing to the reduction of stunting in children under 2 by increasing coverage of evidence-based health and nutrition practices among pregnant and lactating women (PLW) and caregivers.

Methods: SC used the ***Peer Support Group Approach*** to deliver preventive nutrition interventions directly to beneficiaries including promotion of maternal and child health and nutrition (MCHN) practices among PLW, elderly caregivers, men, community and religious leaders. In addition, a **Community Action Planning (CAP)** approach was used to establish Development Committees, develop community-led solutions, and strengthen community engagement in the adoption of appropriate MCHN behaviours.

Results: Endline evaluation among beneficiaries revealed reduced stunting rates from 20.8% to 13.8%, and minimum acceptable diet increased from 35.7% to 54.2%. The knowledge of key MNCH practices increased significantly among women (84.9%) and men (81.8%), increase consumptions of grains/roots, dairy, flesh foods and vitamin A-rich fruits & vegetables for children 6-23months and women of reproductive age. Also, over 40% of women reported making decisions for their own and their child's health and nutrition, while 77% of men agreed that decisions regarding the health and nutrition of mother and child should be jointly made.

Conclusions: In Vanuatu, the use of proven approaches like peer support groups and investing in community activities that are directly linked to support health and nutrition outcomes increased the adoption of MCHN behaviours and will inform scale-up to other Pacific Countries.

Keyword: Stunting, Support Groups, Nutrition, Behaviours, Community

PAB(T3)-103

The Effect of Dietary Medium-Chain Triglycerides for High School Sports Club Students.

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Background and Objectives: The present study, a survey was conducted with rapidly growing late adolescent high school athletes with the aim of understanding basic figures such as pre- and post- exercise physical measurements, body metabolism, and effective exercise performance fatty acids intake. The participants (n=24; male=11, female=13) in the study were first- and second-year high school students who belong to their school's basketball club.

Methods: Data collection in the study consisted of the participant's physical measurements and blood test, and their Rating of Perceived Exertion (RPE) before and after exercise. The exercise intensity was calculated using the Metabolic Equivalents (METs) of daily club activities. The participants completed a dietary intake survey using Brief-type self-administered Diet History Questionnaire for 15-years-olds (BDHQ15y). The participants also completed a physical measurements and blood test, and a Rate of Perceived Exertion (RPE) before and after exercise. We investigated the effect of a 2-week regiment of food containing medium-chain triglycerides (MCT) and long-chain triglycerides (LCT).

Results: Results of the study showed significantly higher values Creatine Kinase (CK) after the 2-week period. Participants also showed no significant difference between males and females before and after. No severe adverse effect was observed.

Conclusions: This study suggests that MCT intake up to 6g/day is safe for high school students. Further study will be needed to define of muscle fatigue reduction.

Keyword: Medium Chain Triglycerides, High School Students, Basket Ball

PAB(T3)-104

Estimation of the Sodium-to-Potassium Ratio by Meal Patterns in Japan

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Background and objectives: Prevention of hypertension is an important health issue in Japan, and sodium and potassium play an important role in the development of hypertension. Recently, there has been an increased interest in the sodium-to-potassium (Na:K) ratio as an indicator of salt and potassium intake. Our study focused on dietary Na:K and aimed to compare the Na:K ratio of meal patterns in Japan.

Methods: Female dietetics college students (n=237) were invited to participate in the study in April 2021. We collected anthropometric measurements, 24-hour urinary sodium and potassium excretion data, and one-day meal records. We excluded participants who did not provide consent, had missing data, provided an unrealistic food record, or if the dietary Na:K ratio was not consistent with urinary Na:K excretion (Bland–Altman analysis). The final sample for analysis was 144. Calculation of sodium and potassium content of the meals was performed using the Standard Tables of Food Composition in Japan 2020. Dishes were classified into 16 categories by type and combined for the meal. The Na:K ratio was examined by meal patterns.

Results: Comparison of the 10 most frequently occurring meal patterns revealed that the combination of "staple food,main dish,side dish,soup" had a higher salt content compared with "staple food,main dish,side dish" and "staple food,main dish" (median 3.3 g vs. 2.2 g and 1.6 g, respectively,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

all p < 0.05); however, there were no significant differences in the salt content between any other combinations. The Na:K ratio was significantly lower in "staple food,main dish,side dish" compared with "combined dishes," "combined dishes,beverage," and "staple food,side dish" (median 1.2 vs. 2.1, 2.3, and 2.7, respectively, all p<0.05).

Conclusion: The combination of "staple food,main dish,side dish" had a lower Na:K ratio than "combined dishes" despite no significant difference in sodium and salt. This result indicates that the combination of "staple food,main dish,side dish" is recommended for better health outcomes.

Keyword: staple food, main dish, side dish, sodium-to-potassium ratio

PAB(T3)-105
A core outcome set for pregnancy nutrition research (PRENCOS)

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Background and objectives: Core outcome sets (COS) are lists of the most critical outcomes to report in an area of research. Their use helps to standardise outcome reporting across studies, enabling systematic reviews and meta-analyses. Given the role of diet in a promoting a healthy pregnancy and the large heterogeneity in outcome reporting in this area, a COS for pregnancy nutrition is urgently needed. The aim of this study is to develop a COS for pregnancy nutrition research (PRENCOS).

Methods: Candidate outcomes were identified through a systematic review of intervention and observational studies and one-to-one semi-structured interviews with women with experience of pregnancy (n=26) that were transcribed and analysed using inductive thematic analysis. Outcomes were consolidated, organised into domains, and categorised using the Core Outcome Measures in Effectiveness Trials (COMET) taxonomy. Plain language definitions were developed and piloted during the interviews. A two-round, modified Delphi survey (May-August 2021) invited healthcare professionals (HCPs), researchers, and women to vote on how critical each outcome was to include in PRENCOS using a nine-point Likert scale. All outcomes that did not reach consensus were discussed at a consensus meeting.

Results: 53,091 papers were identified, and outcomes were extracted from 427. The qualitative data yielded 45 outcomes and an additional 24 came solely from the literature. After refinement, 30 outcomes were included in the Delphi survey. In round one, 82 participants ranked each outcome, nine additional outcomes were suggested, and one was included in round two. In the second round, participants (n=60) voted 12/31 outcomes as critical to include PRENCOS (pregnancy complications; anaemia, gestational weight change; maternal vitamin and mineral status; mental health; diet quality; nutritional intakes; need for treatments, interventions, medications, and supplements; pregnancy loss or perinatal death; birth defects or congenital anomalies, neonatal complications, new-born anthropometry and body composition). The remaining 20 were reviewed at the consensus meeting and two outcomes were included (maternal wellbeing and delivery complications). Anaemia was incorporated into maternal vitamin and mineral status, resulting in 13 outcomes in PRENCOS.

Conclusions: Use of PRENCOS will support standardisation in outcome reporting across dietary studies in pregnancy. This will ensure researchers measure what matters most from the perspective of key stakeholders and enable high-quality evidence generation on the impact of diet on these critical maternal and child outcomes.

Keyword: Pregnancy, Nutrition, Diet, Outcomes, Core Outcome Set

Conflict of Interest Disclosure: None

Further Collaborators: This publication has emanated from research supported in part by a peer reviewed research grant from Science Foundation Ireland (SFI) under Grant No. 12/RC/2273 and 16/SP/3827 and by a research grant from PrecisionBiotics Group Ltd. The funding source did not have a role in the design of the study or manuscript preparation.

PAB(T3)-106
Optimal IYCF practices and nutritional status among refugee and host community children- Implications for policy and programming

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Introduction: In humanitarian settings, the risks to feeding and caring practices for Infants Young Children and their mothers are high. These risks aggravate their vulnerability to diarrhoea and other diseases due to poor sanitation, reduced access to food and deterioration in living conditions.

Objective: This study assessed the nutritional status IYCF practices among children 6-59 months of age

Methods: A cross-sectional quantitative survey was undertaken among women of rreproductive age with children 6-59 months. 456 households were sampled in Palorinya refugee settlement, Uganda representing 70:30 ratio of refugee and host populations. A multi-stage cluster sampling design was adopted for this study. Comparisons between the different groups and bivariate analyses were also made to establish relationships between dependent and independent variables.

Results: Global Acute Malnutrition was prevalent at 8.1% among the sampled children in the host communities and 7.2% in the refugee settlement. Severe wasting was more prevalent in the host communities (2.3%) among children 6-17 months

(6.1%) compared to the refugee settlement (1.1%). Underweight was higher in host communities than in refugee communities (14.8 vs 13.3%). Over 90% of the children in both communities were reportedly breastfed. However, 18.7% in the settlement and 6.3% in the host communities received pre-lacteals in the first 3 days after birth. Bottle-feeding was highly prevalent in the settlement than in the host communities (34% Vs 25%). Only 33% of the children in the settlement and 38.2% in the host communities achieved minimum dietary diversity. A further 48.9% of the breastfed children in the refugee settlement and 58.6% in host communities achieved minimum meal frequency compared to only 13.3% of the non-breastfed children in the settlement and none in the host community. Only 16% of the breastfed children in the settlement and 25.7% in the host communities achieved minimum adequate diet (MAD). 13.3% of the non-breastfed children in the settlement and none in the host communities achieved MAD.

Conclusion: IYCF practices are sub optimal in both refugee and host communities. More attention may be required for programmes to focus interventions in the host communities to improve integration, health and nutrition outcomes of the populations.

Keyword: Infant and young child feeding, Nutritional status, Refugee settlement , host communities

Conflict of Interest Disclosure: The authors of this abstract declare no conflict of interest.

Further Collaborators: Not applicable

PAB(T3)-107
Exploring the role of genetically determined BMI in infancy, childhood and early adulthood on colorectal cancer development in later life

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Background and objectives: Compelling evidence implicates obesity as a major factor in colorectal cancer (CRC) development. We hypothesize that varying obesogenic inherited predisposition in early- and later-life stages may differentially impact the onset of adulthood CRC. We are currently examining genetically determined BMI across the life-course in association with CRC risk, within a pilot project funded by the International Hundred K+ Cohorts Consortium (IHCC); https://ihccglobal.org/announcing-recipients-of-ihcc-pilot-project-awards/.

Methods: Using published GWAS-associated SNPs with obesity, we have constructed specific genomic risk scores (GRS) for obesity in infancy, childhood, and adulthood. We will assess their association with CRC risk and whether the associations differ by age, sex, and select modifiable exposures, utilizing large, international cohort studies contributing to the IHCC, from Europe, North America, China, Japan, and Korea (UK Biobank, EPIC, GECCO, and ACCC). In a related Mendelian Randomization (MR) analysis (led by collaborators Dr Nikolaos Papadimitriou and Dr Neil Murphy), we constructed genetic instruments (derived from a GWAS of 453,169 UK Biobank participants) for 'recalled' early life body size at age 10 (305 SNPs) and measured adult BMI (557 SNPs). These were then associated with CRC risk via a meta-analysis of three genetic consortia (CORECT, CCFR, & GECCO) of 125,478 participants (58,131 cases and 67,347 controls).

Results: By the conference date, we will present our GRS analysis results. In the multivariable MR analysis, genetically-predicted adult body size was estimated to increase risks of colorectal, colon, and proximal colon cancer (but not distal or rectal cancer). After accounting for adult body size, genetically-predicted early life body size had no significant association with colorectal (OR: 0.97, 95% CI: 0.77-1.22) colon (OR: 0.97, 95% CI: 0.76-1.25) or distal colon cancer (OR: 1.27, 95% CI: 0.90-1.77), although the latter finding had a similar magnitude but more imprecise estimate to the significant result in the univariable analysis (OR: 1.25, 95% CI: 1.04-1.51) (Papadimitriou et al 2022, *manuscript in review*).

Conclusions: Our results thus far suggest that childhood adiposity putatively influences CRC risk due to a long-term effect of remaining overweight throughout life. Further research is required to further examine the role of early life body size in distal colon cancer risk.

Keyword: obesity, colorectal cancer, life-course, genomic risk scores, Mendelian randomization

Conflict of Interest Disclosure: All authors have no conflicts to disclose.

Further Collaborators We wish to acknowledge all our colleagues and participants involved in the UK Biobank, EPIC, ACCC, GECCO, CORECT, and CCFR cohort studies.

PAB(T3)-108
The relationship between Body Mass Index and menstrual disorders among University of Ghana undergraduate athletes and nonathletes.

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Background and objectives: Menstruation is a natural periodic uterine bleeding due to the reduced production of estrogen and progesterone during healthy young women's lives. There are several types of menstrual disorders which include dysmenorrhea, premenstrual symptoms, oligomenorrhea, polymenorrhoea, abnormal bleeding, amenorrhea, and menorrhagia. These disorders are affected by factors such as Body Mass Index (BMI), dietary intake, and stress. This study

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

aims to identify the relationship between BMI and menstrual disorders among University of Ghana athletes and nonathletes.

Methods: A cross-sectional survey of undergraduate females between the ages of 16-27 from the University of Ghana was conducted. A semi-structured questionnaire was used to collect background information of the participants, history of the menstrual cycle, and anthropometric measurement. The variables were described using means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Athletes and non-athletes (16-27 years) anthropometric data were categorized as underweight, normal weight, and overweight. Pearson's correlation and binary logistic regression were used to predict the odds of association between menstrual disorders and BMI.

Results: The total number of students who participated in the study was 104. Out of this number, 37 (36%) were athletes, and 67 (64%) were non-athletes. Most of the participants were between the ages of 16-27 with mean ages of 20.76 ±1.44years for athletes and 20.52±1.70years for non-athletes. There was a statistical significance between oligomenorrhea and age and also, oligomenorrhea and BMI. The majority of the participant had normal BMI with a percentage of 59.1% for nonathletes and 59.5% for athletes. The presence of pain during menstruation has the highest distribution of 73% and 79% respectively in both athletes and non-athletes (P = 0.41). Pain during menstruation was prevalent in both athletes and non-athletes but was not statistically significant.

Conclusions: This study revealed that there is a higher prevalence of dysmenorrhea in athletes than in nonathletes. The association between dysmenorrhea, irregular menstrual cycle, primary and secondary amenorrhea, and BMI in both athletes and non-athletes was found to be statistically insignificant. A statistically significant association was found between BMI and Oligomenorrhea and also BMI and age.

Keyword: Body Mass Index, Menstrual disorders , Athletes

PAB(T3)-109
Regional variations in the growth status and prefecture-specific indicators among Japanese infants and young children

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Background and objectives: In Japan, universal health coverage and regular health checkups for infants and young children may contribute to their favorable health status. However, the current status of child malnutrition have not been examined across the 47 prefectures in Japan. This study aimed to assess regional variations in the growth status and prefecture-specific indicators among Japanese children under 5 years old.

Methods: Data on the 2010 National Growth Survey on Preschool Children were used for this analysis (n=6,584). Growth status (Weight-for-age z-score (WAZ), length/height-for-age z-score (HAZ), body mass index (BMI)-for-age z-score (BAZ), weight-for-height z-score (WHZ)) were evaluated with reference to the WHO growth standards. Maternal working status, birthweight by gestational age (BWGA), pre-pregnancy BMI, gestational weight gain (GWG), maternal smoking status during pregnancy, smoking status of father or family member during pregnancy, birth order was considered as exposure. We calculated the prefecture-specific means for each indicator and examined the associations between growth status and indicators.

Results: The prevalence of underweight (WAZ<-2), stunting (HAZ<-2), wasting (WHZ<-2), and overweight including obesity (WHZ>2) was 3.4%, 7.1%, 2.3%, 1.5%, respectively. Most of the prefectures' mean WAZ were close to -0.5, ranging from -0.67 in Nagano to 0.03 in Akita. HAZ was ranging from -0.91 in Tokushima to -0.15 in Akita. BAZ was ranging from -0.34 in Nagano to 0.17 in Akita. WHZ was ranging from -0.35 in Nagano to 0.18 in Akita. Multiple regression analyses found that prefecture-specific HAZ means were positively associated with BWGA and GWG, and negatively related with maternal working status and birth order.

Conclusions: This study shows that the regional disparities in malnutrition among children under 5 years in Japan are relatively small. Given the high prevalence of stunting, further studies are needed to determine other social factors which may affect child growth, such as poverty.

Keyword: regional variations, growth status, risk factor, children under 5 years old, Japan

Conflict of Interest Disclosure: None declared

Further Collaborators: None

PAB(T3)-110
Dietary risk factors for esophageal cancer in a Zambian population

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Background and objectives: Esophageal cancer (EC) is one of the leading causes of cancer related deaths in East Africa, and risk factors influencing its development are being investigated in several countries within the region. The aim of this study was to identify contributory dietary factors associated with EC in Zambia.

Methods: We conducted a hospital-based case-control study in Lusaka, Zambia. Cases were patients with EC while the controls were healthy individuals. Dietary data were collected using interviewer-administered food frequency questionnaires (FFQs). We included commonly consumed foods in Zambia, adapted from an FFQ that was used in a previously published gastric cancer study. In the questionnaire, we enquired how often each food type was consumed and considered it regular if it was consumed at least one a week. Data were analysed in Stata version 15.

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DOI: 10.1159/000530786

Results: We included 361 individuals (123 cases and 229 controls). Among cases, the male to female ratio was 1.6:1 and the median age was 56 years (IQR 46-65years). Unadjusted odds ratios showed an association between regular consumption of salted fish (OR 2.0, 95% CI 1.1-3.5; *P*=0.02) and EC. There was a negative association with regular fruit intake (OR 0.5, 95% CI 0.3-0.8; *P*=0.001) or cassava (OR 0.5, 95% CI 0.3-0.9; *P*=0.01) and EC. Adjusted odds ratios using stepwise logistic regression showed the three food types when consumed regularly were independently associated with EC: salted fish (OR 2.7, 95% CI 1.4-5.3; *P*=0.003), fruit (OR 0.3, 95% CI 0.1-0.9; *P*=0.03) and cassava (OR 0.4, 95% CI 0.2-0.8; *P*=0.007). There were no significant associations with regular intake of beans, maize meal, chicken, pork, beef, eggs, rice, vegetables or smoked fish.

Conclusions: Regular consumption of fruit or cassava is protective against EC, while salted fish increases the odds of developing the disease. Cancer prevention messages should encourage regular consumption of fruits and use of non-salt based food preservation techniques.

Keyword: Esophageal cancer, Diet, Salt, Fruit

Conflict of Interest Disclosure: No conflicts of interest to be declared

Further Collaborators: None

PAB(T3)-111
Exploration into School-Children's Food Preferences Aged between 7 and 12 Years: What Do We Know?

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Background and objectives: Feeding practices exert a definite influence over children's experiences. The study aims to explore parental feeding practices and investigate the prediction domain of food preference from parent-child perspectives.

Methods: Two individual studies were conducted on Malay families with children aged 7 to 12 years. In Study 1, mothers (n=17) participated in semi-structured focus group interviews on their knowledge of foods and feeding practices. In Study 2, parent-child pairs (n=14) answered a 36-item, 5-point Likert scale Food Preference Questionnaire followed by virtual structured qualitative interviews. The interviews were digitally recorded, transcribed verbatim, backtranslated, and analysed according to the framework analysis technique.

Results: In Study 1, mothers perceived vegetables, chicken, fish, and plain water as healthy foods and drinks while discretionary options were snacks, fast foods, and carbonated drinks. The mothers defined healthy foods as foods handled safely with health benefits. They used 'healthy' cooking methods to prepare preferred foods and overtly controlled the child's access to discretionary food. In Study 2, the food groups reported by parent-child pair's report were consistent for the most preferred foods [snacks, median (IQR), parent: 4.5 (1.0) vs child: 4.5 (0.0), p>0.05] and least preferred food [legumes, parent: 2.0 (1.0) vs child: 2.0 (1.0), p>0.05]. Parents cited taste as the most significant determinant of food preference.

Conclusions: These studies were the first to qualitatively explore parents' perceptions of foods affecting their feeding practices among the Malaysian community to highlight the cultural contribution. Key insights into children's food intake and factors influencing their food preferences were identified.

Keyword: food, parenting, school-aged children, family, Malaysia

Conflict of Interest Disclosure: None to be disclosed

Further Collaborators: None

PAB(T3)-112
Food Quality Factors to increase Appetite towards Personalising Nutrition in the Elderly

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Background and objectives: Anorexia or poor appetite can be a major cause of malnutrition and frailty in the elderly. To understand the quality factors of food selection perceived by the elderly and important factors contributing to an increase in appetite and food intake.

Methods: A comparative questionnare survey was conducted between the elderly aged 65 and over (74±5.4 y, n=151) and the adults (55±8.5 y, n=102).

Results: Among elderly subjects, 47.6% had a risk in chewing and swallowing, evaluated by chewing and swallowing risk questionnaire but their self-awareness was low. When the elderly have difficulty chewing or swallowing food, it appers to modify into smaller pieces (72.7%) or adjust the concentration to thinner (18.2%) or to thicker (7.3%). The elderly subjects considered the importance of food quality factors in the order of digestibility, nutrition, chewing comfort followed by taste, health functionanlity, ease of swallowing and raw material quality. As an important factor for promoting appetite, except for taste, the elderly appeared in the order of food texture > nutrition = temperature > atmosphere, and shape, but for adults, there was a difference in the order of flavor > temperature, shape, texture, and nutrition. Additionaly, when a sample with the same sweetness intensity was presented, the elderly perceived the sweetness intensity of the sample improved with nutritional information or prettier shape and preferred it more. It was found that the elderly place importance on 'nutrition and health' when choosing food. Providing information on nutritional enhancement of food can increase the preference for food, and the visual appeal of food has been shown to have a significant effect on the preferences of the elderly.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: In conclusion, it could be important to provide nutritional information and visual appeal to food quality factors in order to increase appetite and food preference in the elderly.

Keyword: appetite, elderly, food quality, nutritional information, visual appeal of food

Conflict of Interest Disclosure: no

PAB(T3)-113
Effects of childhood school lunch intake on skipping breakfast as adults

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Background and objectives: Many reports have shown the evils of not eating (impairment of mind and body, decreased work efficiency and learning ability). In Japan, the rate of skipping breakfast is high and is highest in those in their 20s (about 30%), so measures are required. In Japan, the rate of taking lunch at elementary schools is 99% but varies in junior high schools depending on the municipality. Lunch at school is considered to play a role in education by meals. This study aimed to investigate school lunch and the relationship between current and past eating habits, especially among university students in Kanagawa Prefecture, where junior high school lunches are infrequent provided.

Methods: We conducted a web-based questionnaire of the relationship between current eating habits (breakfast intake, etc.) and past lunch intake in junior high schools. The survey was conducted among students in Yokohama City University and Kanagawa Institute of Technology and with members of the Yokohama City University Alumni Association. Data was performed a survival analysis. Analyzed values were indicated by a risk rate of 5%.

Results: The overall rate of skipping breakfast among the 753 respondents was 32% (27.4% for men; 34.4% for women). The group of Skipping breakfast was higher ate the snacked after dinner than in eat breakfast group. The results of survival time analysis using breakfast skipping as the event showed that the number of skipping breakfast began suddenly increase in adolescents, and new breakfast skippers did not increase rapidly when 20s. The breakfast skipping habit began earliest in adolescents, who were the earliest group to purchase lunch in a store, followed by the lunchbox group and school lunch group, and breakfast skipping habit began at a significantly lower age in this group versus the other two groups.

Conclusions: This study showed that skipping breakfast began in adolescence, and those who continued to skip breakfast during this period developed a habit of skipping breakfast after the age of 20. Education by homeroom teachers and school dieticians was considered the reason for the low number of people skipping breakfast when they became university students.

Keyword: breakfast skipping, school lunch, students, survival analysis, adolescence

Conflict of Interest Disclosure: All authors declare no conflicts of interest.

PAB(T3)-114
Bridging the vitamin A and deworming coverage gap among underserved populations in India through government and civil society organization partnerships

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Background and objectives: In 2006, Vitamin Angels (VA), India partnered with several locally-based civil society organizations (CSOs) in Nagaland state, India to deliver Vitamin A Supplementation (VAS) in capsule form and deworming tablets to increase coverage. During this time, vitamin A coverage increased from 6.7% to 27% (2006 to 2016). In 2016, VA expanded its partnership to provide VAS and deworming (VAS+D) to more CSOs in coordination with the Nagaland State Government (who delivers VAS in syrup form), with the goal of further improving coverage. This study was conducted with the objective to: 1) evaluate VAS+D coverage in Nagaland through government and CSOs partnerships, 2) examine socio-demographic barriers and facilitators to VAS+D coverage, 3) examine associations between socio-demographic characteristics and source of VAS coverage, and 4) to model impact of VAS on health outcomes due to increased coverage through government and CSOs partnerships.

Methods: a cross-sectional survey was conducted in Nagaland to determine coverage of VAS among children aged 6-59 months and deworming among children 12-59 months. Total of 1,272 caregivers of children aged 6-59 months were interviewed.

Results: Most children (77.2%) received VAS in the past six months, of which 28.1% received VAS in capsule form (provided through CSOs) and 70.2% received it in syrup form (provided through government). Total coverage of deworming among eligible children was 74.2%, with 43.5% who received both VAS+D. Barriers to receiving VAS included lower pre-school enrollment (47.4% not enrolled vs 80.9% enrolled, $p<0.001$) and lower maternal education (72.5% less than high school vs 81.9% high school or above, $p<0.001$). Barriers to receiving VAS+D included lack of knowledge of benefits of VAS+D ($p<0.001$). Children of caregivers in lower wealth quintiles were 2.2 times more likely to receive VAS through CSO platform (OR = 2.2, 95%

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

CI: 1.6,3.1) than children of caregivers in higher wealth quintiles. Based on Lives Saved Tool modeling, increasing VAS coverage by 22% through the CSO platform resulted in an estimated 114 stunting cases averted, 25,017 diarrhea cases averted, and 9 lives saved.

Conclusions: Government and CSO partnerships can reduce gaps in VAS+D coverage, especially in areas that are underserved.

Keyword: Vitamin A, Deworming, Children under 5, Lives Saved Tool, India

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: Amy Steets, Vitamin Angels, United States of America

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PAB(T3)-115

The influence of FTO and ADRB2 gene polymorphisms on pregestational BMI and gestational weight gain in women with diabetes mellitus: Results of a randomized nutrigenetic trial

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Background and objectives: Obesity and diabetes mellitus (DM) are multifactorial diseases that increase the risk of adverse outcomes of pregnancy. We investigated the influence of FTO (rs9939609 / rs17817449) and ADRB2 (rs1042713 / rs1042714) gene polymorphisms on pregestational BMI and gestational weight gain (GWG) in pregnant women with DM.

Methods: The study was conducted in a public hospital at Rio de Janeiro/Brazil (2016-2020). Seventy pregnant women with pregestational DM were randomly assigned at the beginning of prenatal care to one of the nutritional intervention groups: traditional diet (a healthy Brazilian dietary pattern) or DASH diet (Dietary Approach to Stop Hypertension), until the childbirth. Pregestational BMI was calculated as pre-pregnancy weight/height². Excessive GWG was the total weight gain above the upper limit of the Institute of Medicine recommendations. Genotyping was performed using real-time PCR. Medians were compared using non-parametric tests. Time-to-event analysis was performed to investigate the risk for progression to excessive GWG.

Results: Participants had 32 (IQR 25.7 – 36.0) years old, 51.4% had type 1 DM. Pregestational BMI was 27.8 kg/m² (IQR 24.4 – 32.3). All women with GG genotype for rs1042714 had type 1 DM and lower pregestational BMI than the CG or CC carriers (23.3 kg/m² [20.1 – 26.4] vs. 28.0 kg/m² [24.6 – 32.4]; p= 0.02). The other polymorphisms evaluated had similar distribution between the types of DM and were not associated with pregestational BMI. There was no difference in GWG between diet groups, 52.9% of women had excessive GWG. Regardless the dietary pattern or DM type, AT carriers of rs9939609 (FTO) and AA carriers of rs1042713 (ADRB2) had higher risk of earlier exceeding GWG compared to TT (aHR 2.4; CI 95% 1.0–5.8; p = 0.04) and GG (aHR 3.9; CI 95% 1.1–13.7; p = 0.03) genotypes, respectively, as the AG carriers for FTO haplotype rs9939609:rs17817449 compared to TT carriers (aHR 1.8; CI 95% 1.0–3.1; p = 0.02).

Conclusions: FTO and ADRB2 gene polymorphisms influenced maternal body weight. It may be considered hereafter to investigate personalized nutrition with potential to protect maternal and child health in pregnancies affected by DM.

Keyword: Nutrigenetics, Gestational weight gain, Maternal obesity, Diabetes Mellitus, Pregnancy

Conflict of Interest Disclosure: There is no conflict of interest.

PAB(T3)-116

Nutrimetry to reduce linear growth retardation by 40% in children younger than 1000 days by 2025; in the health center of the municipality of tenabo, in estate of campeche, mexico.

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Background and objectives: In 2022 the WHA 65.5 resolution supported the application of a comprehensive nutrition plan with the goal of reducing growth retardation by 40% by 2025. Nutrimetry (described extensively in other publications) allows for prevalence comparisons by year and nutrition at-risk groups, assisting in achieving the established goals.

Methods: Data from 328 children was collected from 2010-2017 at the Tenabo health centre, Campeche, Mexico. For the analysis, data crossed were length for age Z score and BMI for age Z-score with nutrimetry, comparing prevalence by year and nutrition at-risk group Z-scores using Kruskal Wallis analysis, resulting in the following prevalences. For the 2010 at-risk group1 0%, 4 11.76%, 7 2.94% and 13 2.94% P=17.64%. 2011 at-risk group1 3.45%, 4 10.34%, 7 3.45% and 13 3.45% P=20.69%. 2012 at-risk group1 3.85%, 4 7.69%, 7 7.69% and 13 0%. 2013 at-risk group1 2.17%, 4 8.7%, 7 4.35% and 13 2.17% P=17.39%. 2014 at-risk group1 0%, 4 13.04%, 7 2.17% and 13 0% P=15.21%. 2015 at-risk group1 0%, 4 10%, 7 0% and 13 0% P=10%. 2016 at-risk group1 5%, 4 17.5%, 7 5% and 13 0% P=27.5%. 2017 at-risk group1 4.88%, 4 9.76%, 7 0% and 13 0% P=14.64%.

Results: At-risk group1 2010-2013 P= 2.36%, 2014-2017 P=2.47%. at-risk group4 2010-2013 P=9.62%, 2014-2017

P=12.57%. at-risk group7 2010-2013 P=4.60%, 2014-2017 P=1.79%. at-risk group13 2010-2013 P=2.14%, 2014-2017 P=0%. We compared the averages of both 4-year spans and found differences of -1.9%, although we found a clear decrease, multiple efforts are needed to achieve the 2025 goals.

Conclusions: At-risk group1 showed persistency in prevalence without significant changes, at-risk group4 with a significant increase, at-risk groups7 and 13 showed a significant decrease in the prevalence of overweight and obesity with short stature, which demonstrates the utility of nutrimetry for understanding the changes that occur in the population of children younger than 1000 days. The authors declare no conflict of interest.

Keyword: Nutrimetry, Nutritional risk groups (at risk group), Z score, cross variable, prevalence (P)

PAB(T3)-117
Study on the Effects of Participatory Obesity Prevention Program for Elementary School Children

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Background and objectives: Obesity in children and adolescents is gaining attention due to the high likelihood that obese children and adolescents will progress to adult obesity. If a child is obese in elementary school, he or she will remain obese throughout adolescence, and the deviation from normal weight will widen. As a result, more proactive prevention and intervention programs for childhood obesity are required.

Methods: This program, which is based on the theory of behavior change, provides experiential nutrition education and play-based physical activity programs to children who attend after-school classrooms and local children's centers in order to develop healthy eating habits and increase physical activity. To assess the program's effectiveness, changes in obesity, nutrition, and physical activity-related knowledge and behavior were quantified and analyzed using SPSS.

Results: Between March and July 2020, a total of 7,597 elementary school students in the first and second grades participated in the program, and 3,280 of them were analyzed for pre- and post-comparative analysis. To begin, the nutritional knowledge score increased by 12.96 points, as did the eating behavior score (P<0.001).The change in physical activity score increased by 0.51 points, while the proportion of children in the maintenance stage, the highest stage in the stages of change in physical activity, increased by 11.6%p (P<0.001).Second, in terms of changes in childhood obesity rates, the ratio of overweight to obese children decreased by 0.2%p, the number of underweight children decreased, and the number of children with normal weight increased. (p<0.05)

Conclusions: Although the change was not significant due to the fact that circumstances such as irregular program operation and restrictions on face-to-face education were reflected as a result of COVID-19 disease control measures, it demonstrated the effect of decreasing the obesity rate in overweight/obese children. It is believed that by allowing children to manage their own healthy eating habits through experiential nutrition/physical activity education, it will be possible to promote the foundation for lifelong health maintenance.

Keyword: Childhood obesity, obesity prevention, elementary school care, nutrition, physical activity

PAB(T3)-118
Maternal Vitamin D Deficiency during the COVID-19 Pandemic in Japan

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Background and objectives: Maternal vitamin D deficiency (VDD) may cause low vitamin D status of infants. However, the characteristics of maternal VDD under the COVID-19 pandemic are unknown. Thus, we aimed to investigate the features of maternal VDD evaluated by questionnaire survey during the COVID-19 pandemic in Japan.

Methods: From December 2021 to April 2022, an online questionnaire survey was conducted for Japanese pregnant women aged 20 years or over. Participants were recruited from all over the country using poster and leaflets at government's maternal and child department or social media. The questionnaire included dietary habits and lifestyles before (by March 2020) and during the COVID-19 pandemic, healthy eating literacy (HEL), and the VDD questionnaire (VDDQ-J). Of the 556 consented pregnant women, 421 were included in the analysis. VDDQ-J score of 31 or higher and not taking vitamin D supplements were defined as VDD. Unpaired t-test, chi-square test, and logistic regression analysis with backward stepwise selection method were performed.

Results: The mean age was 32 years old and primipara was 58.4%. Percentages of women in first, second, and third trimester were 13.3%, 45.8%, and 40.9%, respectively. Thirty-eight percent of subjects took supplements containing vitamin D and 49.9% was VDD. The VDD group was younger (p=0.001), of lower HEL (p=0.001), and tended to have lower food expenditure before the COVID-19 pandemic (p=0.07) than the non-VDD group. Pre-pregnancy body mass index, educational background, employment status, household income, frequency of working remotely, and morning sickness were not significantly different between both groups. Age (odds ratio (OR) : 0.94, 95% confidence interval (CI): 0.89-0.98), HEL (OR: 0.67, 95%CI: 0.51-0.89), and food expenditure before the COVID-19 pandemic (OR: 0.75, 95%CI: 0.59-0.94) were associated with VDD.

Conclusions: Prevalence of VDD was 49.9% and younger age, lower HEL, and lower food expenditure were the characteristics of VDD in Japanese pregnant women under the COVID-19 pandemic. Our findings suggest that more observational or intervention studies are needed to clarify the risk factors for VDD

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

among pregnant women whose dietary habits and lifestyle has changed during the pandemic.

Keyword: Pregnant women, Vitamin D deficiency, Healthy eating literacy

Conflict of Interest Disclosure: This study was funded by Bayer Yakuhin, Ltd.

PAB(T3)-119

The effect of nutritional improvement of children and maternal women participating in the Nutri-Plus program

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1. Korea Health Promotion Institute (Korea)

Background and objectives: This study investigated whether the NutriPlus program improved children and maternal women nutritional status, nutrition knowledge and attitudes in low-income families. The NutriPlus program is developed to improve maternal and child nutritional status in South Korea. Each participant receives specifically designed home-delivered supplementary food packages and nutrition education for 6 to 12 months. Especially, In response to the demand for nutrition education during the COVID-19 pandemic, we were introducing online E-learning system to the NutriPlus participants.

Methods: This study included maternal women(N=7,170) and 1-to 5-year-old children(N=9,924) participating in the program in 2021. Anthropometric, biochemical, and dietary information was collected on pregnant woman and children. Participant nutritional status was determined by anemia prevalence and intake level of 8 main nutrients. Nutrition knowledge and attitude information was collected from the children's guardian before and after the program. All analyses were conducted with SPSS.

Results: The number of children with weight-for-height and height-for-weight percentile less than 10 significantly decreased ($p<0.001$). Anemia prevalence decreased from 44.3% to 11.6% ($p<0.001$) and MAR(mean adequacy ratio) was also significantly increased from 0.74 to 0.86 ($p<0.001$).

Conclusion: The NutriPlus program is a maternal and child nutrition support system that has been promoted throughout Korea for the past 17 years, and has been consistently proving the effect of improving the nutritional status of children and maternal women of low-income families. The total fertility rate in Korea is continuously decreasing, and nutrition management support for children and maternal women, which are at-risk groups in terms of nutrition, is becoming more important. The nutritional improvement results of the NutriPlus program suggested that it is necessary to expand the Nutriplus program coverage for pregnant women and infants.

Keyword: maternal and child nutritional status, nutrition education programs, nutrition supplementation programs

Further Collaborators: This project was funded by the Ministry of Health and welfare in South Korea.

PAB(T3)-120

The association between nutritional status and cognitive development of school-age children in southern Ethiopia – A Cross sectional study

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Background and objectives: Brain's development starts in the womb, continues rapidly during pregnancy and early childhood, while higher cognitive functions continue to mature during school-age. Nutrition and infections impair, at different degrees, the cognitive development and can lead to long-term detrimental effects on schooling and productivity. In the context of intermittent iron and vitamin A supplementation study, the association between nutritional status and cognitive development of schoolchildren at Arba Minch health and demographic surveillance site (HDSS), southern Ethiopia at baseline was assessed.

Methods: Schoolchildren aged 7-10 years (n=986) were enrolled in the study from nine schools. At baseline, height, weight, and hemoglobin concentration (Hb) were collected at the schools. Children were tested and treated for confirmed malaria based on the rapid diagnostic test (RDT) and for soil-transmitted helminths (STH) using the kato-katz test. Cognitive development was assessed using digit span forward and backward, Raven's Colored Progressive Matrices (RCPM) and Visual search cancellation task. Multivariate logistic models were used to assess the association.

Results: The prevalence of STH infection was 43.7% (the infection of ascaris, Trichuris and hookworm was 19.5%, 19.9% and 14.5%, respectively). One in five children was infected by *Schistosoma mansoni*. Only seven children were RDT positive, 23.7% had adjusted Hb < 11.5 g/dL, and 26.9% and 8.6% had height-for-age z-score (HAZ) and body mass index-for-age z-score (BMI-AZ) < -2.0 SD, respectively. Stunted children were respectively almost twice and one and half time as likely as non-stunted children to be in the low 25th percentile of digit span forward (AOR 1.67: 95%CI, 1.17, 2.37) and of performance index (AOR 1.54: 95% CI, 1.05, 2.25). Thinness and anemia were not associated with cognitive outcomes.

Conclusions: Stunting was associated with short term memory and concentration of schoolchildren.

Keyword: Cognitive development, Nutritional status, anemia, stunting, thinness

Conflict of Interest Disclosure: No conflict of interest

PAB(T3)-121
Seasonal and menstrual rhythms of dietary intake - CYCLES in Iceland

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Background and objectives: Hormonal fluctuations may occur with the rhythms of changing seasons and changing phases of the menstrual cycle. This study aims to investigate whether consumption of food from several food groups and intake of macro- and micronutrients differ between two seasons (winter and summer) and within phases of the menstrual cycle (menstrual-, late follicular- and late luteal phase).

Methods: CYCLES is an observational multidisciplinary research project that took place in Iceland in 2016-2017. Data was collected for the same participants over two cross sectional events, including dietary intake. In total 23 healthy female participants, mean (SD) age of 32.1 (5.1) years, completed six 24-hour dietary recalls. Three dietary recalls were collected in summer and three in winter, each spanning across a single complete menstrual cycle. Intake was compared, between seasons and menstrual cycle phases, from selected food groups, as well as intake of energy, macro- and micronutrients. Analyses were corrected for multiple comparisons.

Results: Only a small fraction of the sample achieved the recommended intake of vitamin D, folate, iron and iodine. Mean total energy (SD) was 2026 (532) kcal during the summer and 1932 (436) kcal during the winter. Individual variation was large in dietary intake between seasons: some had higher intake during the winter compared to the summer, while inverse for others with no clear trend. After correction for multiple comparison, no statistically significant difference was observed for dietary intake between seasons. However, the results indicated differences in fiber and iron intake. After correction for multiple comparison, no statistically significant difference was observed in dietary intake within menstrual phases, while indicative for fat, with mean intake (SD) for the same phases at 74g (27g), 84g (26g) and 94g (38g).

Conclusions: After correcting for multiple comparisons, no statistically significant difference in dietary intake was found between seasons nor phases of the menstrual cycle, possibly due to small sample size. However, large individual variations give way to interesting further analysis within the CYCLES Iceland project, where the dietary data will be analyzed along with other lifestyle factors, inflammatory factors and hormonal status.

Keyword: Diet, Nutrients, Seasons, Menstrual phase, Women

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T3)-122
Exploring Dietary Habits and Lifestyle for the Prevention of Menstrual Pain

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Background and Objective: In the recent years, the percentage of working women in Japan has been increasing annually, reaching 44.4% in 2019. Among women-specific health problems, dysmenorrhea and premenstrual syndrome (PMS) often reduce the quality of life of women at the reproductive age, leading to economic losses. The purpose of this study was to compare the food and drink intake and lifestyle habits of the groups with mild and severe menstrual pain, and to identify dietary habits to prevent menstrual pain.

Methods: Healthy women aged 18–39 years were included in the study. Dietary surveys using the brief-type self-administered diet history questionnaire (BDHQ), body composition measurements, and questionnaire surveys on menstrual status and lifestyle habits were conducted. The subjects were divided into two groups: a heavy group consisting of those who answered that the cramps were "painful to the point of falling asleep" and they "cannot spend time without painkillers," and a light group consisting of those who answered that they encounter "no obstacle in daily life" and "almost no obstacle". We compared the amount of nutrient intake against the lifestyle habits and used the SPSS software (IBM, ver. 26) for analysis. Mann–Whitney U-test and χ-square test were used, and the significance level was set at $p<0.05$.

Results: Comparing the intake of nutrients per 1000 kcal in the two groups, the heavy group consumed significantly more saturated fatty acids, especially lauric acid, myristic acid, stearic acid, and arachidic acid, and unsaturated fatty acids, namely the n-6 unsaturated fatty acids, heptadecenoic acid, eicosadienoic acid, alpha-linolenic acid, and linoleic acid ($p<0.05$). Among foods, ham, ice cream, and mayonnaise intake were significantly higher in the heavy group, suggesting that these foods, which are high in animal fatty acids, may be responsible for causing menstrual cramps. The heavy group was also significantly more likely to have pain-related symptoms during PMS, such as lower abdominal pain ($p<0.05$).

Conclusion: Excessive intake of saturated and n-6 fatty acids may lead to pain induction not only in menstrual pain but also in PMS symptoms.

Keyword: Menstrual Pain, Lifestyle, saturated fatty acids, n-6 unsaturated fatty acids, Premenstrual Syndrome

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-123

Status and socio-demographic correlates of processed food consumption among Bangladeshi adolescents: Findings from a nationwide survey

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Background and objectives: Consumption of processed food, including, savory crispy or fried snacks (SCFS), sugary snacks (SS), and sugar-sweetened beverages (SSB) is associated with obesity and the onset of non-communicable diseases. Using data from a nationwide survey, we assessed SCFS, SS, and SSB consumption among Bangladeshi adolescent boys and girls, and reported the sociodemographic factors associated with the consumption.

Methods: We interviewed 4,907 boys and 4,865 girls for 24-hour and 7-day recall on intake of SCFS, SS, and SSB from 82 randomly selected clusters (57 rural, 15 non-slum urban, and 10 slums) in Bangladesh. The weighted prevalence of consumption of SCFS, SS, and SSB was estimated by gender. Multivariable linear regression models were run to estimate adjusted mean differences in the frequency of weekly consumption of SCFS, SS, and SSB.

Results: The prevalence of daily consumption of SCFS, SS, and SSB was 11.6%, 28.9%, and 25.6% among adolescent boys and 4.9%, 24.8%, and 20.7% among adolescent girls. The mean frequency of weekly consumption of SCFS, SS, and SSB was higher among boys (SCFS: 2.50±2.73 times in boys and 1.58±2.11 in girls, $p<0.001$; SS: 4.64±4.45 times in boys, 4.08±3.98 times in girls, $p<0.001$; SSB: 3.99±6.05 in boys and 2.90±5.08 in girls, $p<0.001$). Adolescent boys and girls of older age (15-19 years), belonging to the richest households, living in a female-headed household, and living in non-slum urban areas had a higher frequency of consumption of SCFS. The weekly mean frequency of SCFS, SS, and SSB consumption was higher among girls with mothers having ≧10 years of schooling. The weekly mean frequency of SS and SSB consumption was higher among boys with fathers having ≧10 years of schooling.

Conclusions: The frequency of consumption of SCFS, SS, and SSB was higher in adolescent boys A number of socio-demographic factors are associated with the consumption of SCFS, SS, and SSB among both boys and girls. Policy and programs to discourage the consumption of these processed foods are urgently needed. Future researchers should use quantitative dietary intake methods to determine the contribution of such foods and drinks to the overall intake of salt, sugar, and fats.

Keyword: processed food, adolescents, sugar-sweetened beverages, sugary snacks, savory crispy or fried snacks

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: None

PAB(T3)-124

Dutch women at risk of micronutrient inadequacy during pregnancy

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Background and objectives: Adequate micronutrient intake before and during pregnancy is important for both mother and child. A diet providing adequate micronutrient intakes prior to pregnancy will require less dietary changes during pregnancy and results in a good start in life for the offspring. In this study the micronutrient intakes of women of childbearing age was evaluated to examine if they are prepared for the (higher) demands during pregnancy.

Methods: Food consumption data of women (20-45 yrs.) from the Dutch National Food Consumption Survey 2012-2016 (n=484) and the Dutch Food Composition Database (NEVO version 2016) were used to calculate habitual intakes of micronutrients from foods using the Statistical Program to Assess habitual Dietary Exposure (SPADE). The prevalence of inadequacy was assessed by comparing habitual intakes to the dietary reference values (DRVs) set by the Health Council of the Netherlands for non-pregnant and pregnant women. For micronutrients with an average requirement Beaton's full probability approach was applied to quantify the prevalence with inadequate intakes. If the adequate intake (AI) was available a qualitative evaluation was made.

Results: Compared to DRVs for non-pregnant women, prevalence with inadequate intakes was high (>10%) for vitamins B2 (58%), calcium (52%; 20-24 y olds, 30%; 25+ y olds), vitamin A (38%), folate (36%) and vitamin B6 (19%). With equal or increasing DRVs during pregnancy, for more micronutrients the prevalence with inadequate intakes was high (>10%): vitamin B2 (76%), calcium (52%; 20-24 y olds, 30%; 25+ y olds), vitamin A (47%), B6 (35%), zinc (17%) and vitamin B12 (14%). Median potassium, selenium (only for the AI for non-pregnant women), folate (only for the AI for pregnant women) and vitamin D intakes were below the AI for non-pregnant and pregnant women and therefore no statement on the risk of inadequacy could be made.

Conclusions: Dutch women seem at risk of inadequate micronutrient intakes before, but also during pregnancy. Additional research on nutritional status or clinical signs of health effects is recommended. In addition, food consumption research among pregnant women is recommended to see if a changing dietary pattern in this period may increase the micronutrient intake.

Keyword: micronutrient, inadequacy, pregnancy, preconception, habitual intake

PAB(T3)-125
Closing the gap between maternal and child diet diversity in Nigeria: insights from the 2018 Nigeria Demographic and Health Survey

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Background and objectives: Improving the quality of diets for women and children during the "first 1000 days" is a policy priority in Nigeria but progress is slow. In 2018 only 22% of Nigerian children 6-23 months old met the criteria for Minimum Dietary Diversity Child (MDD-C); a slight increase from 16% in 2013. Maternal diet quality is a known determinant of child diet quality. However, nationally-representative data on women's food group intake were not available until the 2018 Nigeria Demographic and Health survey (DHS). We use these data to describe the relationship between child and maternal diet diversity in Nigeria and highlight implications for design of infant and young child feeding (IYCF) programs.

Methods: We identified 8975 pairs of children 6-23 months and mothers 15-49 years with available data on food groups consumed in the previous 24 hours. For each pair we calculated rates of consumption concordance (i.e. both did or did not consume) and discordance (i.e. one consumed, other did not) across seven food groups. Next, we calculated MDD-C (at least 5 of 8 groups) using the seven food groups plus breastmilk. Finally, we modeled MDD-C assuming each child also consumed any discordant groups consumed by the mother. All analyses were stratified by child age (6-11m, 12-23m) and zone.

Results: Mother-child concordance was high for grains, tubers and roots (90%) and eggs (88%), moderate for legumes and nuts (64%), dairy (73%), flesh foods (74%), vitamin A rich fruits and vegetables (61%), and lowest for other fruits and vegetables (43%). Discordant consumption was more likely by mothers for all groups except dairy. Nationally, MDD-C was 22% per survey compared to 64% modeled. Difference between survey and modeled estimates varied by 38-47% pts across the 7 zones.

Conclusions: Findings suggest that there are food groups available in households that are not being fed to young children in Nigeria. Focusing IYCF counseling messages on these divergent food groups might dramatically increase MDD-C. With the recent addition of MMD-W to the DHS-8 global questionnaire, many countries will be able to do similar analyses to inform IYCF program design and monitoring.

Keyword: maternal child nutrition , diet quality , infant and young child feeding, Nigeria

PAB(T3)-126
Drama as a tool for improving breastfeeding self-efficacy of pregnant women in selected rural communities of Oyo State, Nigeria

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Background: Breastfeeding self-efficacy remains a key modifiable factor which enhances exclusive breastfeeding and positive health outcomes for infants and their mothers. Numerous interventions targeting the prenatal and postnatal periods have been developed to increase the breastfeeding self-efficacy of mothers. There is paucity of studies utilizing drama-based interventions for improving breatsfeeding self-efficacy of women.

Objectives: The study assessed the effect of a drama-based intervention on breastfeeding self-efficacy of pregnant women in rural communities in Lagelu and Egbeda Local Government Areas (LGAs),Oyo State, Nigeria.

Methodology: A quasi-experimental study was conducted. Selected communities in Lagelu and Egbeda LGAs were randomized into experimental and control groups. Using multistage sampling, pregnant women in second trimester were subsquently selected to participate in the study. A total of 200 pregnant women, 100 in the experimental and 100 in the control groups were selected and followed up to one, three and six months postpartum. The six-session intervention comprised a four episode drama that covered factors promoting breastfeeding and two sessions on hygiene practices. Sessions were presented to pregnant women in their communities prior to delivery. Control group received usual antenatal care. Information on socio-demographic characteristics, breastfeeding self-efficacy and pregnancy related issues were obtained using an electronic questionnaire prior to delivery and postpartum. Breastfeeding self-efficacy was assessed using breatsfeeding self-efficacy short form tool and yielded minimum and maximum obtainable scores of 0 and 70 respectively. Scores >52 were categorized as high breastfeeding self-efficacy. Data were analysed using descriptive and inferential statistics.

Results: The mean ages of women in the experimental and control were 27.29 ±6.03 and 28.27±6.68 respectively and 7.0% and 5.0% of experimental and control women had at most tertiary level of education. Pre-intervention, 89.0% experimental and 71% control women had high breastfeeding self-efficacy scores. The mean breastfeeding self-efficacy scores for the experimental women were 57.69±6.45, and, 57.41±6.08, pre-delivery, one, three and six months postpartum, 59.29±.294 and 58.76±.277 respectively (P value=0.00). Corresponding figures for control women were 58.91±.404 and 58.99±.408 (P value=0.00)

Conclusion: The drama-based intervention resulted in an improvement in breastfeeding self-efficacy of mothers in the experimental groups

Keyword: Drama-based, Intervention, Pregnancy, Breastfeeding self-efficacy

Conflict of Interest Disclosure: No known conflict of interest

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Further Collaborators: Sponsored by Nestle Research Foundation

Bangladesh. These findings can be used to design and implement geriatric food and nutrition policies, strategies, and programs.

Keyword: Geriatric population, Diet quality, Dietary diversity, Bangladesh

Conflict of Interest Disclosure: None.

PAB(T3)-127

Gender differences in diet quality and dietary diversity among geriatric population in Bangladesh: Findings from a nationally representative survey

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Background and objectives: With the rising trend of life expectancy in Bangladesh, the proportion of people aged 60 and above is predicted to reach 21.3% by 2030. Healthy dietary practices are critical for healthy ageing in both males and females. However, as Bangladesh lacks national-level data on diet quality and dietary practices in this age group, we aimed to assess the gender-specific status and determinants of diet quality and dietary diversity (DD) among elderly males and females in Bangladesh.

Methods: A total of 4,817 people aged 60 years and above (males:2,482 and females:2,335) were enrolled, interviewed, and anthropometrically assessed from 82 clusters randomly selected from all eight administrative divisions of Bangladesh during 2018-2019. For dietary data collection, we employed a list-based (24-items) recall method and aggregated these items into 10 food groups following FAO guidelines. Diet quality and DD were determined by the consumption of foods from nutrient-rich food groups, the prevalence of inadequate DD (IDD, defined as consumption of 5 food groups out of 10) and the DD score using a 24-hour recall period. We used multivariable logistic regressions to identify factors associated with IDD in males and females separately.

Results: Overall, 58.6% of the elderly population had IDD, with females having a substantially higher prevalence than males (61.2% vs. 56.3%, p=0.028). Men and women had mean (±SD) DD scores of 4.3±1.6 and 4.1±1.7, respectively. Among the food groups, females consumed significantly less fish and eggs than males (fish: 51.0% vs. 57.8%, p=0.002; egg: 17.1% vs. 22.1%, p=0.004). Poor education, residing in rural areas, living in homes with fewer individuals, and living in food-insecure households were associated with IDD in both sexes. Furthermore, among males, higher age and not being currently married were associated with IDD; and among females, lower age, and living in households with poorer and middle wealth status were associated with IDD.

Conclusions: There exists a gender-based disparity in terms of diet quality and several socio-demographic factors that influence DD among the elderly people of both sexes in

PAB(T3)-128

A systematic umbrella review on the effects of size at birth on health, growth, developmental and behavioural outcomes in children and adolescents

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Background: Size at birth, an indicator of intrauterine growth, has been extensively studied in relation to subsequent health, growth, developmental, and behavioural outcomes. A search in PubMed turns up nearly half a million articles - an unwieldy and unmanageable field to navigate. Evidence from the extensive literature on this topic has not been synthesized to understand where there is conclusive knowledge and where more research might be needed. This umbrella review aims to examine the evidence from systematic reviews and meta-analyses on the effects of size at birth on subsequent outcomes in children and adolescents and to identify gaps in this literature.

Methods: We searched five databases from inception to 15 July 2021 to extract evidence from systematic reviews and meta-analyses (PROSPERO CRD42021268843). We synthesized evidence from all the associations identified between 12 size-related risk factors (birthweight and/or gestation) and 69 outcomes grouped in seven themes: (a) mortality and hospitalization (b) neonatal and early childhood acute ill-health (c) lung-related ill-health (d) chronic ill-health (e) growth and nutrition (f) developmental and (g) behavioural and mental health.

Results: 16,641 articles were screened, 318 systematic reviews identified and 1,005 associations between size at birth and outcomes were mapped. Thirteen outcomes had reviews without meta-analysis. Small size at birth was associated with most half of the sub-themes examined 32/56 while large size at birth was associated with fewer outcomes 8/19. Ten reviews, and 69 meta-analyses within these, compared risks by size for gestational age stratified by preterm and term babies. Analyses including the co-occurrence of premature and small-for-gestational-age compared to term appropriate-for-gestational, were ideal and enabled us to understand and distinguish mechanism related to prematurity and intrauterine growth

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

restriction. For mortality and cognition, prematurity was relatively more important that small-for-gestational-age, while for undernutrition being small-for-gestational was more important.

Conclusion: Our study compiles evidence from 1,005 associations, and our results show where there is good, weak, or absent evidence on the roles of prematurity and intrauterine growth restriction in the fetal origins of disease. We identified gaps in risk factors assessed large size at birth, size at birth adjusted for gestational-age and stratification by maturity and growth.

Keyword: Intrauterine growth restriction, birthweight, preterm, risk factors, Review

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T3)-129
Factors related to inter-professional work for food allergy management of childcare workers and food service workers in nursery schools

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Background and objectives: "The Guidelines for Food Allergy (FA) Management in Nursery Schools" provides a shared understanding and organizational management of FA for all nursery school workers, regardless of their occupation. The purpose of this study was to clarify the factors related to inter-professional work (IPW) for FA management, and to establish a system to prevent FA incidents in nursery schools.

Methods: This study used the data from an anonymous self-administered questionnaire survey in 2017 to the workers at 1415 nursery schools in Japan. It included 4245 childcare workers and 1415 food service workers. The Mann-Whitney U test, Kruskal-Wallis test, and logistic regression analysis were used to examine the individual and organizational factors related to about IPW for FA management by each workers.

Results: Both childcare workers(n=2427,57.1%) and food service workers(n=640,45.2%), the score of IPW for FA management has significant differences in term of individual factors such as the years of job experience in nursery schools, organizational factors such as utilization of FA management guidelines in nursery schools, IPW according to FA guidelines and opportunity to share information with other professions ($p<.05$, respectively). In addition, childcare workers have significant differences in term of age, accident experiences related to FA and position of nursery school ($p<.001$, respectively). Both of IPW high-scored childcare workers(n=2336,55.0%)and food service workers(n=609,43.0%) were related to the years of job experience in nursery schools, utilization of FA management guidelines in nursery schools and IPW according to guidelines (odds ratio [95% confidence interval] : 5.84 [1.74-19.6] and 4.07 [1.24-13.34],2.65 [1.62-4.32] and 2.69 [1.19-6.07],3.73 [2.30-6.06] and 2.34 [1.05-5.20], respectively). And, accident experiences related to FA and an organizational factor of opportunity to share information with other professions were particularly related to the high-scored childcare workers (2.22 [1.39-3.56], 4.90 [2.22-10.8], respectively).

Conclusions: The years of job experience in nursery schools, utilization of FA management guidelines and opportunity to share information with other professions were related to the IPW for FA management in nursery schools. Hence, the necessity of awareness of FA management guidelines to childcare workers, while food service workers and promoting the organizational utilization was suggested.

Keyword: Food Allergy, nursery school, inter-professional work, childcare worker, food service worker

PAB(T3)-130
Placental VDR-SOD3 axis mediates the benefits of maternal exercise on offspring health

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Background and objectives: The occurrence of obesity in mothers of reproductive age serve as prominent risk factor for the transmission of obesity and type 2 diabetes to subsequent generations, thus propagating a vicious cycle of metabolic dysfunction. Our previous studies have demonstrated that maternal exercise improves the metabolic phenotypes of offspring in adulthood, including improved glucose tolerance and liver function. Moreover, superoxide dismutase 3 (SOD3) is an exercise-induced, placenta-derived protein that transmit the benefits of maternal exercise to offspring liver via epigenetic changes. Here, we determined coordinated mechanism that responsible for placental SOD3 production by maternal exercise and nutrition.

Methods: To identify the critical regulators for SOD3 expression in placenta of trained dams, we performed RNA-seq of placenta from sedentary or trained dams and analyzed the potential binding sites of putative transcription factors in the Sod3 upstream region. We then established placenta-specific knockout mice using trophoblast-specific protein a (Tpbpa)/adenosine deaminase (Ada) Cre/loxP system to examine its effects on placenta and in vivo glucose tolerance in offspring. Female mice were housed in cages with (Trained) or without (Sedentary) running wheels for 2 wks prior to breeding and during gestation. Offspring were sedentary and normal diet-fed.

Results: RNA-seq revealed that 26 transcription factors were upregulated in the placenta from trained dams. Sod3 reporter assay identified that vitamin D receptor (VDR) signaling is necessary to induce Sod3 expression in trophoblasts, main component cells in placenta. High vitamin D (10,000 unit)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

feeding improved the effects of maternal exercise on hepatic gene expression and glucose metabolism in offspring, however these effects was diminished by placenta-specific Sod3 knockout. Conversely, detrimental effects of maternal low vitamin D (100 unit) diet on offspring metabolism were recovered by the injection of recombinant SOD3 protein using exo utero developmental system. Placenta-specific VDR knockout showed decreases of placental SOD3 production, epigenetic disturbance of hepatic genes, and impaired glucose tolerance in adult offspring.

Conclusions: Placental VDR-SOD3 axis is necessary for the beneficial effects of maternal exercise on offspring glucose metabolism. Cooperative intervention of exercise intervention and vitamin D supplementation may maximize the benefits of exercise to pregnant women and their offspring.

Keyword: placenta, pregancy, obesity, type 2 diabetes, vitamin D

PAB(T3)-131
Differences In Knowledge, Eating Habits, And Lifestyle In Indonesian Students Based On The Ethnic Group During Covid-19 Pandemic

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Background and objectives: During the covid-19 pandemic, a person's behavior related to health tends to get better. One of the community groups experiencing these changes is students. Culture, especially ethnic differences, is one factor that influences behavior changes. This study aims to analyze Indonesian students' differences in knowledge, eating habits, and lifestyle based on the ethnic group during the covid-19 pandemic.

Methods: The design of this study was cross-sectional, with an independent t-test analysis conducted on 941 students from seven ethnicities in Indonesia.

Results: The results showed that as many as 54.1% of students have poor nutritional knowledge. In addition, most respondents experienced changes in their eating habits (89.1%) and lifestyle (64.1%) during the pandemic. Independent t-test analysis shows differences in student knowledge between different ethnic groups (pv=0.008). Meanwhile, there are no differences in changes in eating habits, breakfast, and stress levels in students based on different ethnic groups.

Conclusions: In this study, different tribes did not show different eating behavior. It might be caused by raising awareness about eating healthy food in all ethnic groups.

Keyword: Eating Habit, Ethnic, Lifestyle, Indonesia, Student

PAB(T3)-132
Dietary pattern of iron intake, iron status and haemoglobin level among school age adolescents in a small island of Indonesia

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Background and objectives: Iron deficiency anaemia among adolescents does not only occur in rural and urban areas, but also occurs in small islands that are rarely identified. This study aims to assess dietary pattern of iron intake, iron status and haemoglobin level among school age adolescents in a small island of Indonesia.

Methods: The study used a cross sectional design. It involved 231 adolescent school age of 10-18 years were randomly selected in a small island in Indonesia. Multiple-pass 24 hour-recall, iron food frequency questionnaire consisting 37 food items, and semistructures questionnaire were administered. Variables consisted of sociodemographics, dietary factors and haemoglobin level. Chi-square (X^2) test, exploratory factor analysis, and partial correlation (r) tests were used for data analysis.

Results: Mean age of respondents was 14.8 years. Six iron dietary pattern explaining 45.6% of the total variance were identified: iron dietary pattern 1 (22.6%), iron dietary pattern 2 (5.6%), iron dietary pattern 4 (4.6%), and iron dietary pattern 5 (4.2%) composed of iron-rich, iron enhancing, and iron-inhibiting foods; iron dietary pattern 3 (4.9%), and iron dietary pattern 6 (3.7%) comprised of iron-rich and iron-inhibiting foods. Sex ($X^2=5.2$, $p<0.05$), age group ($X^2=10.0$, $p<0.05$), and having hives or allergic ($X^2=4.7$, $p<0.05$) significantly affected dietary iron intake. Sex ($\beta=0.32$, $p<0.05$), breakfast skipping ($\beta=2.83$, $p<0.05$), and low of mother education ($\beta=0.39$, $p<0.05$) were associated with anaemia among adolescents. Analysis of partial correlation showed statistically significant relationship between iron dietary pattern 1 and dietary iron ($r= -0.241$, $p<0.05$), iron dietary pattern 1 and dietary fiber ($r= -0.142$, $p<0.05$), iron dietary pattern 4 and haemoglobin ($r= 0.217$, $p<0.05$), iron dietary pattern 5 and dietary iron ($r= 0.217$, $p<0.05$), iron dietary pattern 5 and dietary fiber ($r= 0.138$, $p<0.05$), iron dietary pattern 6 and dietary iron ($r= 0.131$, $p<0.05$), dietary iron and haemoglobin ($r= 0.198$, $p<0.05$)

Conclusions: Sex, age group, and having hives or allergic were significantly associated with dietary iron intake. Sex, breakfast skipping and low of mother education were positively associated with anaemia.

Keyword: Adolescents, Iron dietary pattern, Anaemia

Conflict of Interest Disclosure: The author declared that the authors have no conflict of interest

PAB(T3)-133

Assessing women's knowledge on benefits of iron and folic acid and its consumption during pregnancy in northern Nigeria

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Background and Objectives: Anemia during pregnancy remains a public health concern in Nigeria with a national prevalence of 61%[1]. The prevalence is higher in the northern states of Sokoto, Kebbi, Jigawa, Katsina, and Yobe (60%-74%). WHO (2016) recommends daily iron-folic acid (IFA) supplementation beginning as early as possible in pregnancy with a dose of 60mg of elemental iron and 0.4mg of folic acid where the prevalence of anaemia is severe (i.e. >40 percent)? Nutrition International partnered with the government in these five mentioned states since 2019 to improve access to maternal nutrition services with focus on IFA supplementation. A phone survey was conducted in May 2021, to assess women's knowledge on benefits of IFA and its consumption during pregnancy in these states.

Methods: A multi-sampling method was employed for the selection of clusters and respondents who participated in the survey. Thirty clusters were selected across the states according to population proportional to size. A sample of nearly 40 women who gave birth in the past 0-5 months were randomly selected from each cluster, and questionnaires were administered through a telephone interview adopted due to the impact and restrictions caused by the COVID-19 pandemic. A total of 1,091 women completed questionnaires across the 5 states.

Results: About 56% of the women interviewed reported hearing messages on IFA, 50% could describe one benefit or reason for consuming IFA, while 54% reported exposure to behavioral change interventions on the importance of daily IFA during pregnancy. Although about 88% of women reported consuming IFA at least once during pregnancy, 42% consumed at least 90 days and only 17% consumed IFA at least 150 days.

Conclusion: The findings indicate the need to continue to improve the reach of IFA interventions, with related messages, and the need to identify reasons for low consumption of IFA during pregnancy.

Keyword: Iron, Folic acid, Pregnancy, Nigeria

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

PAB(T3)-134

Food security better in rural than urban areas, and associated with less under two diarrhea and undernutrition and having family members without TB in Western Province, Papua New Guinea

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Background and objectives: Papua New Guinea (PNG) has high burdens of Tuberculosis (TB), and for infants and young children, high rates of undernutrition. To understand more about food security and whether it is associated with TB or children's children's growth in TB-affected communities, we looked at food security, two-week prevalence of diarrhea and presence of TB in families in the largest province, remote and sparsely populated, in the country, where we surveyed cross sectionally 750 caregivers of infants and young children under two years in PNG's Western Province's districts.

Methods: A pretested interviewer-administered questionnaire and standard anthropometric methods were used to collect data in TB-affected communities. Data were entered into MWater software and transferred to SPSS version 22 for analysis.

Results: The sample included 403 (53.7%) males, and four age groups: 245 (32.7%) aged 0-5.99m, 97(12.9%) aged 6-8.99m, 94 (12.5%) aged 9-11.99m and 314 (41.9%) aged 12-23.99m. Diarrhea prevalence in the last two weeks was overall 20.7%, differing by age group, with the youngest group having 9% and the oldest three groups 26-29% ($p<0.001$). A Food Insecurity Experience Scale (FIES) used the first 7 questions' responses to calculate a 7-point scale which showed that food insecurity was substantial, with 61.9% of the surveyed households obtaining scores of 5 or higher, and surprisingly higher in urban than rural areas. Caregivers who reported an infant or young child who had diarrhea in the last two weeks had a significantly higher FIES (4.9 ± 2.1 vs 4.5 ± 2.2; $p=0.037$) than those without such a child. Caregivers who reported a family member currently diagnosed with TB or on TB treatment had a significantly higher FIES (5.1 ± 1.9 vs 4.5 ± 2.2; $p=0.002$) than caregivers without such a family member. Being worried about not having enough food was associated with a lower WHZ score, and running out of food was associated with a more wasting.

Conclusions: Even though this study cannot confirm causality, results suggest that food insecurity might be a factor contributing to raising the risk for undernutrition, diarrhea and TB in the province in the surveyed TB-affected communities.

Keyword: Infants and young children , food security, undernutrition, diarrhea, TB

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T3)-135
The outcome of food insecurity on adolescents health in Albania

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Background: The influence of food insecurity on health and welfare of a population has remained the subject of considerable investigations. Nevertheless, restricted exploration has examined its outcome on adolescents' health and welfare in Albania.

Methods: We used statistics from the Jima Longitudinal Family Survey of Youth to observe the social, behavioral and economic factors of their health and welfare. 1,536 individuals were involved in the study. They distributed data associated with food insecurity practices and health status. Logistic regression and trend model was used to inspect the correlation among food insecurity and their health status.

Results: The outcomes showed that the mean (±SD) age of adolescents was 18.3(±1.2). 54.4% of them were female. The size of self-rated health status was moderately unbalanced reaching from 15.2%, 36.8% . Correspondingly, 17.5%, 44.8% and 19.3% of youngsters were food unconfident through every successive round of the study. Experience with food diffidence is intensely related to health status ($\beta = 0.23$, $P < 0.05$) and reduced self-rated health was extra marked for some time ($\beta = 1.17$, $P < 0.001$) and decay after a turning topic ($\beta = -0.27$, $P < 0.001$).

Conclusions: These results suggest that any social, nourishment and public health interventions intended to progress adolescent health should reflect fundamental social factors of health like food insecurity.

Keyword: Food security, Albania, Social determinants, Adolescent health

Conflict of Interest Disclosure: None

Further Collaborators: none

PAB(T3)-136
Nutrition service delivery practices in early newborn care in Burkina Faso

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Background and objectives: Getting timely appropriate services, including nutrition interventions, as part of early essential newborn care (EECN) to those who need them has been shown to reduce neonatal morbidity and mortality. FHI Solutions/Alive & Thrive supported the Ministry of Health in Burkina Faso to conduct a quality improvement nutrition intervention integrated in EENC in 2021. We assessed standard nutrition service delivery practices into EENC in a region in Burkina Faso.

Methods: A cross-sectional study was conducted from March 9-20, 2021, in the "Centre-Nord" region of Burkina Faso. Twenty-nine health care professionals were selected using purposive sampling technique from 18 health centers with direct observation of their nutrition service delivery practices during antenatal care, in delivery room, and in post-partum wards. Data were collected by observation of the counseling on breastfeeding and the care provided to the newborn. Each observation question item was scored as 0 or 1, and the sum represented the score of service delivery. The results were presented using descriptive statistics.

Results: The mean score for nutrition service delivery practices was 9.5 (plus or minus 2.8 SD) and ranged from 2 to 15. The proportion of women who received good nutrition service practices (score greater than or equal to 12) following a vaginal delivery was 25.7%. Of the 35 recently delivered women, 24 (68.6%) had their babies dried immediately after birth, three (8.6%) received skin-to-skin contact, and 14 (40%) received delayed cord clamping. Eight (22.9% of women) were instructed to breastfeed their child immediately after delivery and five (14.3%) were instructed to delay (greater than 24 hours) the newborn's first bath. Thirteen (37.1%) received vitamin K1. The mean score for counseling on breastfeeding was 1.6 (plus or minus 2.8 SD) and ranged from 0 to 13. Of the 53 pregnant women, 7 (13.2%) were counseled on the advantage of colostrum and nine (17.0%) were explained the definition of exclusive breastfeeding.

Conclusions: The overall nutrition service delivery practices toward early newborn care was not satisfactory. Results demonstrate a need to identify health facility and health staff factors for these poor practices and to bring appropriate support to improve these practices.

Keyword: Early newborn care, Nutrition service delivery, practices, Burkina Faso

Further Collaborators: Césaire T. Ouédraogo, Robert Karama, Léonard Bassolé, Aminata Bargo

PAB(T3)-137
Dietary diversity and associated factors of pregnant women from the Free State Province of South Africa: The NuEMI study

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Background and objectives: Dietary diversity is closely linked with nutrient adequacy. During pregnancy nutrient needs are increased, and poor dietary diversity can lead to nutrient deficiencies, which may lead to poor outcomes for both the mother and baby. The study determined the dietary diversity and associated factors among pregnant women participating in the Nutritional Status of Expectant Mothers and their newborn

Infants (NuEMI) study attending an antenatal clinic in a regional hospital in South Africa.

Methods: A cross-sectional study was conducted. Dietary diversity score (DDS), socio-demographics and household food security were determined. Dietary diversity (DD) was assessed using the Women's Dietary Diversity Score; food security using the Household Food Insecurity Access Scale and socio-demographic status using a self-developed questionnaire.

Results: Starchy staples were consumed by most participants (99.4%), followed by meat and fish (80%). Very few participants had eaten organ meat during the previous day (6%). Median DDS was 4 and 52.6 % of participants fell in the medium diversity score category. About one third (32.5%) of participants were categorized as moderately food insecure and 29.9% were severely food insecure. Monthly income ($p<0.0001$), education level ($p<0.0001$), employment status ($p<0.0001$) and owning of a fridge ($p=0.0021$) were significantly associated with dietary diversity. More participants with an income between R0- R3000 (56.1%), those with only secondary education (83.3%) and unemployed participants (74.2%) had a low DDS. Almost all participants that owned a fridge had a high DDS (94.2 %). A significantly higher percentage of participants that had a low DD (40.6%) were food insecure ($p=0.0002$).

Conclusion: A lower monthly income, lower education level, unemployment and food insecurity were associated with lower dietary diversity, while ownership of a fridge was associated with better DD. Interventions should be aimed at encouraging a culture-sensitive, healthy lifestyle with a focus on consuming a diverse diet. Interventions should focus on addressing barriers to healthy lifestyles during pregnancy such as poverty and food insecurity.

Keyword: Dietary diversity, nutrient deficiencies, food insecurity, socio-demographic factors

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T3)-138
Nutritional intervention to prevent progression from pre-frailty to frailty in the elderly with Agaro-Oligosaccharides intake: A Pilot Study.

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Background and objectives: Frailty can be defined as "*a state of reduced resilience to stress due to age-related loss of reserve capacity*," and it is generally regarded as a preliminary step to a state of need for nursing care. Frailty has also been defined as possessing three or more of the following attributes: weight loss, muscle weakness, fatigue, walking speed decrease, and physical inactivity. Pre-frailty is defined as having one or two of these attributes. Agaro-Oligosaccharides (AOSs) is a food product produced by breaking down agar and developed by Ina Food Industry Co., Ltd. AOSs are expected to be effective in ameliorating pre-frailty due to their biological activities, including anti-inflammation and inhibition of muscle atrophy. The purpose of this pilot study is to test whether AOSs intake is effective in preventing the progression from pre-frailty to frailty in the elderly.

Methods: Thirteen male elderly subjects, who agreed to the study were divided into randomized two groups and measured. The primary endpoint was 10-meter Walking Speed test, and secondary endpoints were 30-second Chair-Stand test, Time Up and Go test (TUG), and so on. After assessment of frailty at baseline, pre-frailty subjects were selected. AOSs group (n=3) received 6 AOSs tablets per day and Placebo group (n=5) received 6 placebo tablets per day for 12 consecutive weeks in a double-blind controlled study. The above measurements will be performed 4, 8, and 12 weeks after ingestion, and proof of effect is planned to be demonstrated by a no correspondence T-test of difference from baseline.

Results: After 8 weeks, the difference from baseline in 10-meter Walking Speed was +0.48 ± 0.08 m/sec in the AOSs group versus +0.08 ± 0.21 m/sec in the placebo group ($p = 0.012$). After 4 weeks, the difference from baseline in TUG was -2.18±0.41 sec in the AOSs group versus -0.55±0.94 sec in the placebo group ($p = 0.016$), and after 8 weeks that was -2.55±0.53 sec in the AOSs group versus -0.95±0.93 sec in the placebo group ($p=0.021$).

Conclusions: AOSs intake expected to be effective for prevent progression from pre-frailty to frailty by increase in walking speed.

Keyword: Pre-Frailty, Frailty, Elderly, Agaro-Oligosaccharides, Pilot study

Conflict of Interest Disclosure: Materials have been provided from Ina Food Industry Co., Ltd.

PAB(T3)-139
One-carbon metabolism-related nutrients during youth and young adulthood and breast density

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Background and objectives: One-carbon metabolism is a complex network of biochemical reactions involving multiple B vitamins that helps maintain DNA integrity and epigenetic signatures. Intake of one-carbon metabolism-related nutrients may enhance genomic stability of the breast, particularly during rapid growth and development that occurs before full differentiation following the first full-term pregnancy, which could lower breast cancer risk. We examined long-term associations between youth and young adult intakes of one-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

carbon metabolism-related nutrients and breast density, a strong risk factor for breast cancer.

Methods: During 18 years of follow-up in the Dietary Intervention Study in Children (DISC) and the DISC06 Follow-up Study, diets of 176 women were assessed by three 24-hour recalls on five occasions between ages 8-18 and at ages 25-29. Multivariable-adjusted linear mixed-effects regression was used to examine associations between intakes of one-carbon metabolism-related nutrients and MRI-measured percent dense breast volume (% DBV) and absolute dense breast volume (ADBV) at ages 25-29.

Results: Folate intake during youth was significantly inversely associated with % DBV and ADBV. Mean % DBV decreased from 20% to 17% from the lowest to highest quartile of folate intake (P_{trend}=0.008), while ADBV decreased from 80.0 cm^3 to 68.0 cm^3 (P_{trend}=0.03). Inverse associations of folate with breast density phenotypes were significant among postmenarche but not premenarche girls. Among postmenarche girls, % DBV decreased monotonically from 22.0% to 16% across increasing quartiles of folate (P_{trend}=0.02), while ADBV decreased monotonically from 92.6 cm^3 to 67.1 cm^3 (P_{trend}=0.008). In contrast among premenarche but not postmenarche girls, ADBV increased monotonically from 67.2 cm^3 to 92.3 cm^3 across increasing quartiles of vitamin B2 intake (P_{trend}<0.001). Young adult folate and vitamin B6 intakes were significantly inversely associated with % DBV; with increasing quartiles of intake, mean % DBV decreased from 23.6% to 17.2% for folate and from 20.8% to 15.1% for vitamin B6 (both $P_{trend} \leqq 0.02$). Young adult vitamin B6 intake also was significantly inversely associated with ADBV; mean ADBV decreased from 74.0 cm^3 to. 63.0 cm^3 with increasing quartiles of intake (P_{trend}=0.01).

Conclusions: One-carbon metabolism-related nutrient intakes during youth and young adulthood were associated with % DBV and ADBV, suggesting possible long-term influences on breast cancer risk.

Keyword: One-carbon metabolism related nutrients, Youth and early adulthood, Breast density, Breast cancer risk, Timing of exposure

PAB(T3)-140
A high protein low glycemic index diet limits gestational weight gain in pregnant women with overweight or obesity

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Background and objectives: More than 30% of pregnant women are overweight or obese before pregnancy and more than half of these exceed the recommendations for gestational weight gain (GWG). Both pre-pregnancy overweight and excessive GWG increase the risk of complications and offspring obesity. We aimed to investigate the effect of a high protein low glycemic index (HPLGI) diet on GWG among pregnant women with obesity.

Methods: In this randomized controlled trial, 279 women with pre-pregnancy overweight or obesity (BMI 28-45 kg/m^2), aged 18-45 years and in their late first trimester with singleton pregnancies were included. The women were allocated to one of two ad libitum diets: an HPLGI diet (25-28% of energy from protein and glycemic index below or equal to 55) or a moderate protein moderate glycemic index diet (MPMGI: 15-18% of energy from protein and glycemic index of approximately 60) from gestational week 15 and throughout pregnancy. The women received dietary guidance from a clinical dietician nine times to facilitate adherence. GWG was calculated as the last measured weight before birth minus the self-reported pre-pregnancy weight and magnetic resonance imaging was performed at gestational weeks 15 and 28 and just after birth.

Results: A total of 105 and 104 women out of 141 and 138 randomized to the HPLGI and MPMGI diets completed the intervention (75%). In the available case analyses, GWG was 6.8 ± 1.3 kg among women assigned the HPLGI diet and this was significantly lower by -1.7 kg (95%CI -2.8, -0.5; P=0.004) than the GWG of 8.5 ± 1.3 kg among women assigned the MPMGI diet. There were no differences between diet groups in changes in liver, muscle, subcutaneous or visceral fat contents. There were no reported maternal, fetal or neonatal deaths and the incidence of miscarriages (1-2%) was equal in the two groups.

Conclusions: A moderate increase in dietary protein in conjunction with a reduction in the glycemic index during the last two trimesters of pregnancy reduced GWG among women with overweight or obesity.

Keyword: Genstational weight gain, Dietary intervention, Birth weight, Pregnancy

Conflict of Interest Disclosure: The study received research funding from The Nordea Foundation, Danish Pig Levy Foundation, Danish Dairy Research Foundation and Danish Agriculture & Food Council, and products from LEGO Charity, PharmaNord and Pharmo Vital.

PAB(T3)-141
Effects of Lutein complex supplementation on improving dry eyes syndrome in healthy young subjects

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Background and objectives: Dry eye syndrome (DES) is the highly prevalent ophthalmological problem, and the age of patients has a trend of becoming younger. Long-term use of steroids for dry eye treatment could cause early cataract and increased intraocular pressure. Clinical studies have reported that lutein supplementation could reduce oxidative stress

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

damage caused by blue light exposure and prevent age-related macular degeneration; however, lutein alone did not improve dry eye symptoms. Therefore, we would like to study whether the combination of lutein with other supplements could improve dry eye.

Methods: This study was aimed to explore whether lutein combined with other antioxidants and phytochemicals could improve dry eye syndrome and visual function. In this experiment, twenty-six young healthy subjects were recruited and took lutein complex supplementation daily (20mg free lutein, 4mg free zeaxanthin, 40mg maqui berry extract, astaxanthin, 80mg BS7® bilberry extract, flaxseed oil, and vitamin E) for eight weeks. Corrected visual acuity, contrast sensitivity, intraocular pressure, dry eye test, tear break-up time, macular pigment optical density (MPOD), and serum lutein level were assessed on the baseline, week 4, and week 8 of the experiment. The eye comfort level was assessed by questionnaires.

Results: The results showed that after the intervention of lutein complex supplementation, the serum lutein level, MPOD, dry eye test, tear break-up time, and eye comfort level were significantly increased (p<0.05); moreover, intraocular pressure was significantly decreased (p<0.05), but did not affect visual acuity, contrast sensitivity, and central macular thickness.

Conclusion: Lutein complex supplementation has beneficial effects on improving dry eye syndrome, the serum lutein level, and macular pigment optical density.

Keyword: Lutein, Zeaxanthin, Maqui berry extract, Bilberry extract, Dry eye syndrome (DES)

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

PAB(T3)-142
Nutritional intake and determinants of nutritional quality during pregnancy and postpartum - a longitudinal study

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Background and objectives: It is well known that adequate energy and micronutrient intake during pregnancy and lactation are important for health of both women and their children. However, longitudinal studies investigating nutritional intake and quality in pregnancy and postpartum among Swedish women are lacking. Our objectives were to 1) describe nutritional intake and quality from third trimester to 18 months postpartum, and 2) study the determinants of change in nutritional quality.

Methods: Women were studied longitudinally (n=72) at gestational week 35-37, two weeks, four, twelve and 18 months postpartum. At each study visit maternal characteristics and four-day food diaries were collected. The estimated intake of macro- and micronutrients were compared to reference values from the Nordic Nutrition Recommendation 2012. Nutritional quality was assessed by the energy adjusted Nutrient Rich Food Index 11.3, including eleven nutrients to encourage and three nutrients to limit. Linear mixed models were used to analyze change in nutritional quality and its potential determinants.

Results: The average estimated intake for most nutrients, except vitamin D, exceeded the average requirement both in pregnancy and postpartum. However, less than 40% of the women adhered to recommended intakes of saturated fat, fiber, vitamin D, folate, and iron at all study visits. The carbohydrate energy percentage [E%] and fiber intake were higher in third trimester compared to postpartum. In contrast, the E% of protein and monounsaturated fat increased from third trimester to postpartum. Estimated intakes of vitamin A, vitamin C, and potassium were higher in third trimester compared to postpartum. Overall, nutrition quality did not differ significantly from third trimester to postpartum. Shorter duration of lactation was related to decreased nutritional quality over time, whereas higher age and BMI were related to increases.

Conclusions: Macro- and micronutrient intake differed from third trimester compared to postpartum. Determinants of change in nutritional quality were lactation, age, and BMI. Low adherence to recommended intake of certain nutrients during pregnancy and postpartum highlight the necessity of qualified dietary counselling during this period in life.

Keyword: maternal health, pregnant women, lactation, diet, nutrients

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

PAB(T3)-143
Maternal plant–based diets and neonatal DNA methylation: Findings from the Avon Longitudinal Study of Parents and Children (ALSPAC)

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Background and objectives: Adherence to vegetarian/plant–based diets (PBDs) during pregnancy has been related to fetal outcomes such as lower birth weight. DNA methylation (DNAm) is a possible biological mechanism underlying this relation. We performed an epigenome–wide association study (EWAS) to examine cord blood DNAm in relation to maternal PBDs during pregnancy.

Methods: A total of 693 British mother–child pairs with both pregnancy food frequency questionnaire and cord blood DNAm data were included. PBD adherence was assessed using 3 indices (all ranging from 18 to 90): an overall plant–based diet index (PDI), a higher score representing greater plant food intake; a healthful (hPDI) and unhealthful PDI (uPDI) further distinguished between intakes of healthy and unhealthy plant foods. DNAm was measured by Illumina 450K arrays. Linear regression adjusted for maternal age, education, parity, child sex, blood cell

types, and batch (Model 1). Model 2 further adjusted for maternal lifestyle factors. We excluded polymorphic sites and performed functional analyses and lookups for the findings.

Results: At p−value <1×10^{-5}, there were 3 (cg13180232, cg24265806, cg04896381), 1 (cg11760198), and 2 (cg22254580, cg24810917) differentially methylated cytosine−phosphate−guanine (CpG) sites identified in Model 1 in relation to PDI, hPDI, and uPDI, respectively; only cg13180232 passed the threshold for false discovery rate (FDR) correction (FDR−corrected p=0.049). Associations were slightly strengthened in Model 2 for most CpG sites. Neither model identified any overlap between top CpGs for the 3 indices. According to the EWAS Catalog, adult rheumatoid arthritis and maternal glucose levels have previously been associated with cg04896381 (in *TBKBP1*) in whole and cord blood, respectively, and clear cell renal carcinoma with cg24810917 (in *ODZ4*) in adults. cg22254580 (in *GOLGA3*) was associated with gene expression of *ANKLE2*, *CHFR*, *ZNF605*, and *ZNF84* in a publicly available *cis*−expression quantitative trait methylation database from child blood. Based on our EWAS results, we identified 1 differentially methylated region associated with PDI on chromosome 3:128968351−128968543 (in *CFAP92*, effect estimate=-2.55×10^{-3}, standard error=4.14×10^{-4}, p=7.09×10^{-10}). No firm evidence of enrichment was found for gene ontology, pathways, or tissue−specific DNaseI hypersensitivity regions.

Keyword: Plant-based diet, Pregnancy, Birth, Epigenetics, Intrauterine programming

Conclusions: Adherence to different PBDs during pregnancy was associated with differential cord blood DNAm patterns.

PAB(T3)-144
Effects of a meat-based complementary diet on infant growth, sleep activity, and neurodevelopment.

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Background and objectives: The impact of complementary feeding on infant growth, sleep activities, and neurodevelopment is not clearly understood. This study aimed to evaluate the effects of a meat-based complementary diet on these health indicators.

Methods: 37 healthy 5-month-old full term, exclusively breastfed infants were recruited from the Denver metro area (Colorado, USA); participants were randomized to an intervention or control arm. Infants in the intervention group consumed pureed meat daily until 12 months of age at 1-2 jars per day (prescribed), while infants in the control group followed standard-of-care. At 6, 9, and 12 months of age, sleep activity was obtained using the Micro-minimotionlogger actigraph from Ambulatory Monitoring Inc. (Ardsley, New York). Infant anthropometry was also measured. At 12 months, neurodevelopment was evaluated using the Bayley-III developmental assessment. Results presented are preliminary data.

Results: Infant weight-for-age z-score [WAZ] and weight-for-length z-score [WLZ] at 6 months averaged -0.61 ± 0.14 and -0.17 ± 0.15, respectively, for combined groups. At 12 months, WAZ averaged -0.48 ± 0.13; WLZ averaged -0.13 ± 0.11 for combined groups; these changes are not statistically significant. The 24-hour average sleep fragmentation index [SFI] decreased significantly from 1.71 ± 0.18 at 6-months to 0.98 ± 0.45 at 12 months (effect of time p=0.006), without differences between group. The 24-hour average sleep duration changed significantly in the intervention group only, from 1281 ± 21.53 minutes at 6 months to 1340 ± 12.88 minutes at 12 months (p=0.04). Pearson's correlation at 12 months revealed positive associations between sleep duration and growth in the control group (WAZ p=0.03) and intervention group (WLZ p=0.03 and WAZ p=0.04). Infants in the intervention group performed better than the control in Social-Emotional development and Adaptive Behavior (Communication, Social, Self-Care) evaluations by the Bayley-III assessment.

Conclusions: In these preliminary analyses, complementary diets with varying meat intakes potentially influenced infant growth trajectories, sleep activities and neurodevelopment scores. These data suggest the important role complementary feeding plays in infant development, warranting further investigations with large sample sizes of the underlying mechanisms of the diet-growth-sleep/neurodevelopment interplay to make definitive conclusions.

Keyword: Infant, Sleep, Nutrition, Growth, Complementary feeding

PAB(T3)-145
The association between asymmetric dimethylarginine and sarcopenia in community-dwelling older women

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Background and objectives: Asymmetric dimethylarginine (ADMA) is a modified amino acid and an endogenous inhibitor of endothelium nitric oxide synthesis. Increased ADMA causes endothelial dysfunction. Several studies have shown a relationship between endothelial dysfunction and a decline in muscle mass and grip strength in older adults. However, the association between ADMA and sarcopenia in older adults has not been studied. We evaluated the correlations between plasma ADMA levels and sarcopenia in community-dwelling older women.

Methods: Participants in this study included community-dwelling elderly women living alone who attended annual health examinations at voluntary lunch events. Plasma ADMA levels were measured in our laboratory using a competitive enzyme-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

linked immunosorbent assay. Sarcopenia was assessed according to the guidelines of the Asian Working Group for Sarcopenia 2019 Consensus.

Results: Plasma ADMA levels in participants with sarcopenia were significantly higher than in those without. A receiver Operating Characteristics curve estimated the cutoff value of plasma ADMA for sarcopenia at 0.57 mM. In those with higher plasma ADMA, the ratio of sarcopenia was significantly greater than in those with lower ADMA group (48.0% vs. 16.8%, *p*= 0.002). Logistic regression analysis found a crude odds ratio of higher plasma ADMA levels of 4.57 (95% CI, 1.82–11.47; *p*= 0.001). The association between sarcopenia and plasma ADMA levels remained significant after adjustment for relevant variables. Reductions in the skeletal muscle mass index over 2 years were significantly greater in those with higher plasma ADMA.

Conclusion: Increased plasma ADMA levels were significantly associated with sarcopenia in community-dwelling older women.

Keyword: sarcopenia, asymmetric dimethylarginine, grip strength, skeletal muscle mass, community-dwelling older women

PAB(T3)-146
Different gut microbiota in US. formula-fed infantsconsuming meat vs. dairy-based complementary foods

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Background & objectives: Limited research has addressed the effects of solid foods (complementary foods) on infant gut microbiota development, especially in relationship with infant growth trajectories. This project aimed to evaluate the impact of meat- vs. dairy-based complementary foods on gut microbiota and how it relates to growth.

Methods: Full-term, formula-fed infants were recruited from the metro Denver area (Colorado, US) and randomized to a meat- or dairy-based complementary diet from 5 to 12 months of age. Infant's length and weight were measured every month, and stool samples were collected at 5, 10, and 12 months. 16S rRNA gene sequencing was conducted and short-chain fatty acids were analyzed in the stool samples.

Results: 64 infants completed the dietary intervention (n=32 per group), 61 stool samples were collected at baseline (5 months), 54 at 10 months and 56 at 12 months. Overall, Weight-for-age Z scores increased over time in both groups and length-for-age Z scores (LAZ) increased in the meat group only, which led to a significant group-by-time interaction (P=0.02) of weight-for-length Z score. Microbiota composition (Beta-diversity) differed between groups at 12 months (weighted PERMANOVA P=0.015) and had a group-by-time interaction of P=0.090. Microbial community richness (Chao1) increased in the meat group only. Several taxa changed over time at the genus level, including *Bifidobacterium, Escherichia-Shigella, Blautia* and *Ruminococcus*. A significant fold change of butyric acid from 5 to 12 months was found in the meat group (+1.75, P=0.011) but not in the dairy group. However, the quantitative analysis did not reveal a significant effect of time or group. Regression analysis showed that Chao1 had a negative association with WLZ and WAZ. Several genera also had significant associations with all growth Z scores.

Conclusion: Complementary feeding not only impacts infant growth but also affects gut microbiota maturation. Complementary food choices can affect both the gut microbiota diversity and structures. In addition, these complementary-food-induced changes in gut microbiota are associated with infant growth.

Keyword: microbiota, infant, complementary feeding, growth

Conflict of Interest Disclosure: No conflict of interest.

PAB(T3)-147
Investigation of reasons for skipping breakfast among female university students in nutritionist training courses -Is it true that there is no time?-

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Background and objectives: Many studies have cited lack of time as a reason for skipping breakfast. In this study, we examined female university students in the nutritionist training course to see if they actually did not have time to eat breakfast.

Methods: 64 female university students enrolled in the dietitian training course were asked to take a questionnaire on breakfast, record their daily activities for one week, and conduct a survey on their breakfast intake status and lifestyle activities. The subjects were divided into three groups: the group that did not skip breakfast (group I), the group of 1 ~ 3 days a week of skipping breakfast (group II), and the group of 4 ~ 7 days a week of skipping breakfast (group III). Approved for the Tokyo Kasei Gakuin University Ethics Review.

Results: 64 peoples responded to the survey, with 51 valid responses. As a result of the daily life survey, the waking time on weekdays was 7:00±1:05 in group I, 7:25±0:44 in group II, and 7:12±0:45 in group III. The time from waking up to going out on weekdays was 82.1±14.4 minutes in group I, 88.8±22.3 minutes in group II, and 84.4±18.2 minutes in group III, with no significant difference among the three groups. The time required to prepare breakfast was 7.1±1.2 minutes in Group I, 5.5±6.0 minutes in Group II, and 6.6±8.5 minutes in Group III, with no significant difference observed. When people in Groups II and III who skipped breakfast were asked why they skipped breakfast,

50% said they wanted more sleep, 31% said they didn't have time to eat breakfast, and 9% said they didn't have time to prepare breakfast.

Conclusions: This suggests that people who skipped breakfast have physical time, but they do not have time psychologically, and that eating breakfast is a low priority among daily activities after waking up.

Keyword: skipping breakfast, time

PAB(T3)-148
Nutritional status in poor rural elderly in six elderly centres in rural Tamil Nadu, India

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Background: Nutrition plays a vital role throughout life course and is especially important at extremes of life for preventing morbidity and premature mortality due to disease. Elderly population have to deal with various physical, psychological, social and financial conditions influencing their nutrition and quality of life. RUHSA hospital takes care of health and socio-economic development of 138,000 population of the K V Kuppam block (an administrative unit of government). In response to the community's needs of taking care of elderly population left behind to fend for themselves due to their children moving out for jobs or being too insecure financially to take care of their parents, the poorest of the poor elderly were chosen by RUHSA to provide least a nutritious meal per day, yearly medical check-up and a facility (elderly centre) for group exercises, social participation and exchanging life experiences. Nutritional assessment was done for all elderly chosen under this scheme.

Methods: Data on Socio-demographic characteristics, weight and height was collected and 24-hour dietary recall method was used to collect data on food variety and quantitative intake. These were used to assess the nutritional status in terms of BMI and nutritional deficiencies.

Results: In the six elderly centres under RUHSA, nutritional assessment was done for 49 elderly individuals of which 39 (79.6%) were females. The mean age of elderly population was 67.2 $\pm$ 7.3 years, 40 (81.6%) were Hindus and rest Christians. Except one, all belonged to backward castes. 40 (81.6%) lived in their own houses and rest in relatives' house or unused public shelters. 32 (65.3%) were illiterate and all were currently unemployed. Old age pension by government was only source of income for 37 (75.5%) of elderly and rest had no means of subsistence. Nutritional status assessment revealed that 22 (44.9%) of elderly were underweight and all of the were practically under nourished with total calorie deficiency, protein and fat deficiency. Micro-nutrient deficiency was seen among all with specific deficiency of vit. B2, Vitamin C, iron and zinc.

Conclusion: Poor nutritional status and micronutrient deficiency was common among the poor elderly population of rural Tamil Nadu, India.

Keyword: nutritional status, elderly, micronutrient deficiency

Conflict of Interest Disclosure: None

PAB(T3)-149
Associations of coffee and tea consumption with dysmenorrhea among reproductive-age women in Beijing, China: a cross-sectional study

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Background and objectives: Dysmenorrhea is the most common health-related problem in reproductive-age women. It can reduce the quality of life and hinders social activities, especially when it as accompanied by symptoms such as headache, fatigue, nausea and vomiting, diarrhea, chills and muscle cramps. Despite the association between drinks and dysmenorrhea, especially coffee and tea consumption, the results of association are still inconsistent. Therefore, the aim of the current study was to investigate the associations of coffee and tea consumption with dysmenorrhea among women in the reproductive age.

Methods: A cross-sectional study was conducted on 1247 women who participated in the health screening at 6 community health service centers in Beijing from September to November, 2021. A validated food frequency questionnaire (FFQ) was used to measure the consumption of drinks. Dysmenorrhea severity was assessed with the use of the Numeric Pain Rating Scale (NPRS). Multinomial logistic regression was performed to assess the association of drinks and dysmenorrhea. Other information, such as demographic factors, was also collected and assessed in relation to dysmenorrhea.

Results: Dysmenorrhea affected 92.9% of the interviewed women. Among them, 69.0%, 21.7% and 2.2% had mild, moderate and severe dysmenorrhea, respectively. Regular consumption of coffee (More than 1 cup/bottle per day, 1 cup/bottle ≈ 300 mL) was associated with a higher prevalence of dysmenorrhea (for mild dysmenorrhea: aOR =1.97 (95% CI 1.03 to 3.79); for moderate-to-severe dysmenorrhea: aOR =3.27 (95% CI 1.59 to 6.73)). Regular intake of green tea and bubble tea appeared to positively associated with the prevalence of moderate-to-severe dysmenorrhea (green tea: aOR =3.02 (95% CI 1.31 to 6.96); bubble tea: aOR =2.91 (95% CI 1.31 to 6.43)). Occasional coffee consumption was also associated with moderate-to-severe dysmenorrhea (aOR =2.19 (95% CI 1.20 to 3.99)), whereas occasional intake of green rea and bubble tea had no association with dysmenorrhea. No association of red tea and flower tea consumption was observed with dysmenorrhea.

Conclusions: Drinking coffee and tea were associated with a higher prevalence of dysmenorrhea.

Keyword: coffee, green tea, bubble tea, dysmenorrhea

PAB(T3)-150
Survey on dietary characteristics of Nikkei residents living in Paraguay and Brazil (Nikkeijin), and Japanese living in Japan

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Background and objectives: Japanese migration to Paraguay in 1955 and to Brazil began in 1908. The main objective of this study is to determine the relationship between protein intake and diet in people of Japanese ancestry living in Paraguay and Brazil and Japanese living in Japan.

Methods: Subjects were 25 Nikkeijin living in Itapua prefecture of Paraguay 30 Nikkeijin living in Sao Paulo, Brazil and 87 Japanese living in Japan(50 young and 37 middle-aged). Dietary intake was assessed using comprehensive (Japanese residents) and brief-type (for Paraguayan and Brazilian residents) dietary history questionnaires(a self-administered diet history questionnaire: DHQ,and Brief-type self-administered diet history questionnaire:BDHQ).

Results: The mean age of Nikkeijin living in Paraguay was 52 years, that of Nikkeijin living in Brazil was 51 years, that of middle-aged Japanese living in Japan was 48 years, and that of young Japanese was 18 years. There were no significant differences in amount of protain intake and carbohydrate intake among Nikkeijin living in Paraguay and Brazil and middle-aged Japanese. However, young people living in Japan had significantly higher fat intake.

Conclusions: There were no differences in dietary characteristics between Nikkeijin living in Paraguay and Brazil and middle-aged Japanese living in Japan, but the diets of young people were associated with significantly higher fat intake and unhealthy diets.

Keyword: Nikkeijin, Japanese, nutrition, protein intake, Nikkei residents

PAB(T4)-1
Clinical, Physical, and Nutritional Effects of Weight Loss Program for Obese and Infertile patients

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Background and objectives: In recent years, obesity and insulin resistance have been reported to reduce fertility. Therefore, it is important for obese females who wish to have children to lose weight toward the healthy weight. We examined the effects of a team-based weight loss program on clinical and nutritional changes in obese females seeking infertility treatment.

Methods: Forty-seven obese females with a BMI of 30 kg/m^2 or more wishing to be treated for infertility and to participate in the weight loss program were enrolled in this study. We analyzed changes in body compositions during the program and compared blood pressure, laboratory data, intake of nutrients and food before and after the weight loss interventions. We compared these parameters between subjects with and without successful pregnancies within one year after the program.

Results: During the program period, body weight, body fat mass, skeletal muscle mass, BMI, and body-fat percentage significantly decreased, while the ratio of skeletal muscle mass vs body fat amount significantly increased. Blood pressure, HOMA-IR, AST, and ALT decreased significantly after the program compared to the baseline. Furthermore, the intake of energy, fat, n-6 polyunsaturated fatty acids, carbohydrates, salt, meats, confectioneries, beverages, fat and oils decreased significantly. In contrast, the intakes of light vegetables, mushrooms, algae, and fish and shellfish increased significantly. There were no differences in body weight loss and BMI between those with and without a successful pregnancy.

Conclusions: Our team-based weight loss program improved the nutrients, body weight, body compositions, thereby leading to the improvement of blood pressure, liver function and insulin resistance.

Keyword: Body composition, Obese, Nutritional guidance, Multidisciplinary approach

PAB(T4)-2
Nutrition-related risk of severe hypoglycemia outpatient settings among older adults with and without diabetes

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Background and objectives: The Geriatric Nutritional Risk Index (GNRI) helps to assess the risk of complications (aspiration pneumonia, pressure ulcers, etc.) and mortality associated with malnutrition. However, it is not clear whether the GNRI are associated with hypoglycemia in outpatient settings. In this study, we investigated the association between severe hypoglycemia and nutrition-related risk among outpatients.

Methods: This study investigated the nutritional status of outpatient settings with severe hypoglycemia who presented at the emergency department of the Soka Municipal Hospital, a secondary care institution in Japan, using electronic medical records. Outpatients aged ≧65 years presenting with severe hypoglycemia between September 1, 2018, and June 15, 2021 were eligible for this study. Patients with missing data on height, weight, or serum albumin levels, precluding GNRI calculations

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DOI: 10.1159/000530786

were excluded. The patient characteristics and the association between nutritional status and severe hypoglycemia were descriptively summarized.

Results: Seventy-five outpatients presented with hypoglycemia that required 50% glucose injection. Among them, 58 patients experienced impaired consciousness. Overall, 17 patients had data on serum albumin levels, height, and weight values that were required for the GNRI calculation. Four (23.5%) were type 1 diabetes patients, 5 (29.4%) were type 2 diabetes patients, and 8 (47.1%) were without diabetes. Severe hypoglycemia occurred even in patients who were not receiving treatment to lower blood glucose levels. Thirteen of 17 (76.5%) had nutrition-related risks. Among 8 patients without diabetes, 1 patient had insulin autoimmune syndrome, which may cause spontaneous hypoglycemia; consequently, this patient was excluded from further analysis. Among patients without and with diabetes, the median GNRI was 68 (67.0-81.5) and 95 (92.0-100.0), respectively.

Conclusions: We conducted a detailed investigation of older adult outpatients who developed severe hypoglycemia, and found that they had problems with their nutritional status as assessed by GNRI, regardless of whether they had diabetes or not. To prevent the occurrence of hypoglycemia in the future, we would like to identify high-risk patients, including their nutritional status, and examine whether interventions to improve their nutritional status can reduce the risk of occurrence of hypoglycemia.

Keyword: Nutrition, Hypoglycemia, Geriatric Nutritional Risk Index, GNRI

PAB(T4)-3
About the current state of diet remedy and Eating habits satisfaction of adult type 1 diabetic patients

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Back ground and objectives: Type 1 diabetes can lead a life similar to that of a healthy person if proper dietary intake and insulin supplementation are performed accordingly, but it has various problems because the treatment lasts for a lifetime. Therefore, we conducted a questionnaire survey of patients and investigated their current dietary status.

Methods: A questionnaire survey was conducted on 16 adult type 1 diabetic patients belonging to the patient association in Chugoku region of Japan.

Results: According to the results of the questionnaire, none of the patients answered that they "use the food exchange table frequently", and 38% of the patients answered that they "use it occasionally". 38% of patients said they "use the carbohydrate counting method" and 38% said they "use it occasionally". When asked if their daily diet was stressful, 25% said they "think very much" and 25% said they "think a little". When asked that they couldn't enjoy their meals because they were concerned about blood sugar control, 25% said they "think very much" and 25% said they "think a little". When asked if they were satisfied with their diet and treatment, 25% said they "think very much" and 38% said they "think a little". When asked where to get information about meals after the onset, it was "patient association, advice from doctors and nurses, study sessions, online information, etc."

Conclutions: The patients who responded to this questionnaire were 30 to 70 years old, 13% had a medical history of 3 to 5 years, 38% had a medical history of 5 to 10 years, and 50% had a medical history of 10 years or more. There were many patients who developed the disease when dietary guidance was relatively strict. In this survey, many patients were stressed by the diet itself, but even in the previous survey, none of them received dietary guidance at each visit, and information from patient associations seems to be important. Now that the weight of diet in the treatment of type 1 diabetes is increasing, we feel the importance of the opportunity to provide appropriate nutrition (diet) information to patients.

Keyword: adult type 1 diabetic patients, Eating habits satisfaction

Conflict of Interest Disclosure: There are no conflicts of interest to disclose.

PAB(T4)-4
Development and implementation of a structured nutrition education course for caregivers of children with type 1 diabetes in Uganda.

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Background and objectives: Structured nutrition education courses for pediatric type 1 diabetic patients and their caregivers are lacking in Africa and this has been cited as one of the contributing factors to suboptimal management of type 1 diabetes (T1D) in the region. Furthermore, it is important that culturally appropriate structured nutrition education courses informed by the local context be developed and made readily available to caregivers as parental care positively influences glycemic and dietary outcomes of children with T1D. The objectives of the study were to develop a structured nutrition education course for caregivers of children (3-14 years) with T1D in Uganda and determine its effect on the level of T1D nutrition knowledge of the caregivers.

Methods: The study was a cluster randomised controlled trial in which 100 caregiver-child dyads were assigned to a control group and intervention group. The participants in the control group continued to receive routine medical care, while those in the intervention group received routine medical care and attended a structured group nutrition education course. The intervention lasted 12 weeks, it consisted of 8 face-to-face

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

sessions lasting 45 minutes each. The content of the training course was informed by gaps identified from a document review and needs assessment. A two-member team of a diabetes specialist nurse and a specialist diabetes dietician conducted the sessions.

Results: There was a significant difference in caregivers' nutrition knowledge scores following their participation in the structured nutrition education course ($p < 0.001$). The median nutrition knowledge score increased from 32% to 45 % post-intervention. There was no statistically significant difference in the children's glycated haemoglobin (HbAlc) levels following their caregiver's participation in the structured nutrition education course ($p = 0.748$).

Conclusions: A structured nutrition education course for caregivers of paediatric T1D patients can improve their nutrition knowledge. However, the lack of detection of a significant change in the children's HbA1c could be that glycated haemoglobin is influenced by various factors beyond nutrition knowledge which could be the case in this study since nutrition knowledge among caregivers improved.

Keyword: Diabetes, Nutrition, Education, Caregiver, Uganda

PAB(T4)-5
Effects of simultaneous carbohydrate and alcoholic beverage intake on blood triglyceride levels after fat loading at dinner

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Background and objectives: The Blood triglyceride (TG) level increases after consumption of a high-fat diet and alcoholic beverages. It is important to confirm whether there is an increase in chylomicron (CM) remnants, which are highly atherogenic, to consider the relationship between alcoholic beverages and health. This study aimed to determine the effects of simultaneous alcoholic beverage and carbohydrate intake on the blood TG level during a fat tolerance test.

Methods: The subjects were 16 healthy male volunteers in their 20s to 40s. The high-fat diet was adjusted to 50 g fat per body surface area using gyusara (stewed beef) and fat loading cream. The alcoholic beverage used was 1400 ml beer (61.6 g ethanol) and the carbohydrate used was 150 g white rice (50 g carbohydrate). Four meals were loaded: A (gyusara), B (gyusara + beer), C (gyusara + white rice + beer), and D (beer). Blood samples were drawn during fasting and at 30, 60, 120, 180, 360, and 720 minutes after meals. Measurements of TG, apoB-48, RLP-C, sd-LDL, glucose, and insulin levels were taken.

Results: After 720 minutes, TG, apoB-48, and RLP-C levels were significantly ($p < 0.05$) higher for B and C than for A. The level of sd-LDL was significantly higher for B than for A ($p = 0.002$), but there was no significant difference between sd-LDL levels for C and A. Insulin levels at 180 minutes were significantly lower for B than for C ($p = 0.014$).

Conclusions: Hypertriglyceridemia was observed after 720 minutes of simultaneous ingestion of a high-fat meal and alcohol. The high apoB-48 level suggested that the TGs may be CM remnants. Simultaneous ingestion of carbohydrates may result in lower sdLDL levels, which was predicted to be an effect of increased insulin secretion due to carbohydrates and lipoprotein lipase activation by insulin. When consuming alcoholic beverages, the risk of atherosclerosis could be altered by the combination of the amount of fat and carbohydrates that are simultaneously consumed.

Keyword: Postprandial hyperlipidemia, apoB-48, alcoholic beverage intake, high-fat diet, dyslipidemia

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T4)-6
Excessive folic acid supplementation in pregnant mice induces glucose and lipid metabolic disorders in their offspring in infancy and/or adulthood.

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Background and objectives: Previous studies have shown that excessive maternal intake of folic acid (FA) predisposes to impaired glucose tolerance in the offspring. Then, we will examine ways to improve the situation. Therefore, we aimed to determine whether excessive FA intake during pregnancy affects the glucose and lipid metabolic disorder of mouse offspring in infancy and adulthood.

Methods: Pregnant C57BL/6J mice were fed AIN93G diet containing either 2 mg [control group (CN)] or 40 mg [high FA group (HFA)] FA/kg diet throughout their pregnancies. Experiment 1: On postnatal days (PD) 22 and 50, fasting blood glucose was measured in the offspring of both groups (n=10), and an oral glucose tolerance test (OGTT) was performed on PD 50. On PD 53, tissues were collected, and the tissue masses, area of insulin expression in the pancreas, liver triglyceride content, and gene expression were determined. Experiment 2: After weaning, each group (n=8) was fed a high-fat and high-sucrose diet (HFHS) to induce lifestyle-related lesions. Half of the groups were fed a diet in which a part of sucrose was replaced with fructooligosaccharides (FOS), and the changes in each group were observed.

Results: In female infant, the blood glucose concentrations were higher in HFA than CN offspring in infancy at 60 and 120 min of the OGTT. The serum insulin concentrations and the area of insulin expression in the pancreas were lower in HFA than CN offspring. The liver triglyceride content was higher in HFA offspring than CN offspring ($P < 0.05$). The liver mRNA expression

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of fat synthesis genes, *Pparγ2* (male and female) and *Cidec* (male), were higher in HFA than CN offspring ($P < 0.05$). In female adulthood mice adipose tissues accumulation due to consumption of HFHS after weaning was suppressed by FOS intake.

Conclusions: Excessive maternal supplementation of FA in mice leads to lower insulin synthesis and an impairment in hepatic glucose and lipid metabolism in the offspring, and the lesions are induced by HFHS in infancy and adulthood. Furthermore, the lesions may be suppressed by FOS intake. We further clarify the health effects of folic acid supplementation.

Keyword: Lipid metabolism, Folic acid, Impaired glucose tolerance, Pregnancy, liver triglyceride

Conflict of Interest Disclosure: Conflict of Interest Disclosure (if any) ⇒ The authors thank Meiji CO., Ltd. for providing fructooligosaccharide.

Further Collaborators: Chihiro Ushiroda, Misaki Kurawaka, Akio Watanabe, Yuko Yamazaki

PAB(T4)-7
Effectiveness of transtheoretical model-based intervention on weight management in obese hospitalized patients

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Background and objectives: Obesity and overweight are global problems related to many chronic diseases. Given that these chronic diseases are important causes of hospitalization, it is reasonable to suspect that overweight and obese individuals would be at a greater risk for hospitalization than normal weight individuals. Several strategies have been used to treat obesity, and these typically emphasize dietary behaviors and physical activity. Here we evaluate the effect of intervention performed according to the stages of change of the transtheoretical model (TTM) for weight management during hospitalization and 3 months after discharged.

Methods: We screened all patients aged from 18 to 65 years, BMI ≧ 27 at a district hospital from July to September, 2019. After receiving their informed consent, we surveyed subjects' stage of change and offered basic information on weight control, nutrition education (individual and group intervention) and stretching class (video) according to their different stages. We collected subjects' anthropometric data as well as their knowledge, beliefs, self-efficacy and health-related dietary behaviors of weight management before and 3 months after discharged from hospital.

Results: A total of 153 patients attended the project and 120 subjects completed at the end. All participants (n=120) had an average body weight of 82.4±12.4 kg in the beginning and 79.9±12.1 kg at the end of the program (p<0.001). There were 67% of the subjects were at the stage of pre-contemplation (36%) and contemplation (31%) in the beginning, and only 26% of the subjects were at the stage of pre-contemplation (13%) and contemplation (13%) after intervention (p<0.001). There was no significant differences in knowledge of weight control; however, it was significantly increased in their self-efficacy and health-related dietary behaviors (p<0.05).

Conclusions: The TTM-based weight control intervention, combined with usual care, was an effective strategy in obese hospitalized patients. These results should encourage the use of interdisciplinary practices; nevertheless, research to identify additional strategies is needed to address barriers to weight maintenance.

Keyword: Obesity, transtheoretical model, hospitalization
Conflict of Interest Disclosure: Nil
Further Collaborators: Nil

PAB(T4)-8
Associations of review patterns of diet foods and drinks with self-reported weight changes among Japanese men and women.

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Objective: Various diet products have been sold for weight control and beauty. Those products users tend to review the products and exchange opinions with the other users as "word-of-mouth communication (WOMC)" on the internet. Previous studies have shown that these WOMC identified several patterns, but few studies examined the association between those patterns and weight changes. Therefore, the purpose of this study was to examine WOMC patterns of diet foods and drinks and weight changes.

Methods: We received the WOMC data registered in the website "Diet Café" managed by T.M.Community Co., Ltd. between 2008 and 2019 (National Institute of Informatics Dataset Joint Use Research and Development Center: doi/10.32130/idr.11.1). A total of 15,822 WOMC with age, sex, height, weight before and after use diet foods or drinks, and period of use were analyzed. The WOMC pattern was identified by cluster analysis. The differences of weight change among those review patterns was tested by analysis of covariance after adjustment for age, sex, weight before use and food form (food / drink).

Results: We identified the following three review patterns. “product effect” pattern characterized as frequently using "effect”, “weight loss” and “constipation", and e.g. “I feel the constipation-relieving effect” and “My weight was reduced after consumption of this food / drink”, “weight change” pattern characterized as frequently using “weight”, “weight loss” and “change”, and e.g. “I feel that weight reduction was smooth after replacement of normal meal with this food / drink in the morning”, and “product detail” pattern characterized as frequently using "replacement”, “taste” and “deliciousness", and e.g. ”this food / drink is rich in taste and delicious”. The multivariable-adjusted mean of weight changes for “product detail” pattern was significantly lower than those for the other

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DOI: 10.1159/000530786

two patterns. The respective multivariable-adjusted weight changes was -0.98 kg for the product effect pattern, -1.37 kg for the weight change pattern, and -1.56 kg for the product detail pattern ($p < 0.05$).

Conclusion: We found that the diet foods and drinks users who reviewed "product detail" pattern as WOMC on the internet had higher weight reduction.

Keyword: Diet review, Cluster analysis

PAB(T4)-9
Chronic exercise combined with restricted diet treatment improved pancreatic dysfunction of pancreatitis and diabetes with obesity in WBN/Kob rats.

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Background and objectives: Leptin receptor-deficient WBN/Kob-Fatty (WKF) rat was developed for a model of chronic pancreatitis and diabetes with obesity. We recently indicated that pancreatic dysfunction in the chronic pancreatitis with obesity could be improved by adequate exercise habit with restricted diet. Furthermore, we obtained that these treatments improved early lesions of pancreatic B-cells and acinar cells in this pancreatitis model rats. The purpose of this study was to investigate whether the autophagy system is involved in the amelioration of pancreatic dysfunction by chronic exercise combined with restricted diet in WKF rats.

Methods: [Animals] Male WKF rats (age, 6 weeks) were divided into fatty-obese (FOB; n=10), fatty-diet restriction (FDR; n=8), and fatty-exercise (FEX; n=9) groups. WBN/Kob (WK; not obesity) rats were used as lean control (C; n=6). [Food] The C and FOB rats had free access to food, the FDR and FEX rats had food intake restricted to 69% and 70% of the FOB level, respectively. [Exercise Training] The FEX rats were exercised voluntarily on the wheel ergometer with a load of 30% on their body weight every day. Mean running distance was 1711±458m/day. [Measurements] Following 6 weeks of experimental period, the pancreas were excised and weighed. Protein content and amylase activity in pancreatic tissue and serum parameters were measured. Autophagy-related protein (LC3) and ubiquitinated protein (UP) protein expression in the pancreas were evaluated with western blotting method.

Results: The FOB rats (12wks) had symptoms of obesity, diabetes, and pancreatitis with increased ER stress (XBP1) and inflammation (IL6) markers in the pancreas, while the FDR and FEX rats had ameliorated these symptoms and the markers. Furthermore, LC3 and UP were indicated same fluctuation as ER stress and inflammation markers.

Conclusion: These results suggested that male 12wks WKF rats had symptoms of pancreatitis and diabetes, but lean WK rats did not. Chronic exercise combined with restricted diet ameliorated these pancreatic dysfunctions induced by obesity with ectopic fat accumulation in WKF rats which may be involved homeostatic regular autophagy system.

Keyword: pancreatitis, obesity, exercise, restricted diet, autophagy

PAB(T4)-10
Effects of obesity-induced leptin resistance on the level of type I collagen in the skin

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Background and objectives: Obesity increases the risk for metabolic disorders and can lead to leptin resistance. Leptin has been reported to influence the function of various cells, including dermal fibroblasts. However, some aspects of the relation between obesity-induced leptin resistance and skin function are unclear. This study aimed to reveal the effect of obesity-induced leptin resistance on type I collagen, which imparts tensile strength and stability to the skin.

Methods: To examine the effect of obesity-induced leptin resistance on the level of type I collagen, we used leptin-deficient *ob/ob* mice, leptin receptor-deficient *db/db* mice and their respective wild-type (WT) littermates as the control (8 weeks old). Skin tissue samples were fixed in 10% formalin neutral buffer solution and embedded in paraffin to use for the histopathological analysis. Serial sections were cut and stained with hematoxylin and eosin, and Masson's trichrome stains. We also investigated the levels of type I tropocollagen, which polymerizes to microfibrillar collagen to initiate aggregation. The levels of type I tropocollagen from the dermal skin were measured by using enzyme-linked immunosorbent assay.

Results: Both *ob/ob* mice and *db/db* mice were heavier than their respective control groups, thereby confirming the obesogenic effect of impaired leptin-signaling. Histological observation of the dorsal skin revealed a marked decrease in the dermal layer in both *ob/ob* mice and *db/db* mice. The skin tissues of both *ob/ob* mice and *db/db* mice showed lower amounts of collagen deposition compared with that in WT mice. The level of type I tropocollagen was significantly reduced in the skin of both *ob/ob* mice and *db/db* mice compared with WT mice.

Conclusions: These findings suggest that obesity-induced leptin resistance reduces the level of type I collagen in the skin, and these effects are deleterious for skin function.

Keyword: Skin, Collagen, Obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-11
The association between diabetic status and BMI change during the COVID-19 pandemic: the Toon Health Study

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Background and objectives: The COVID-19 pandemic had a significant impact on individual's health and health-related behaviors. However, few studies have examined the association of diabetic status with changes in body weight during the pandemic in Japanese population. Therefore, this study aimed to examine the association between diabetic status and Body Mass Index (BMI)change during the COVID-19 pandemic among Japanese population.

Methods: This cohort study enrolled 1349 Japanese men and women aged 30-84 years who participated in the Toon Health Study. Height and weight were measured and BMI was calculated at the baseline survey (2014-2018). In 2021 (May-September), questionnaire survey was conducted and BMI was calculated from self-reported weight and height at baseline. The participants were classified into normal, borderline, and diabetes mellitus (DM) groups based on fasting and 2-hour postprandial blood glucose levels after 75 g oral glucose tolerance test, and diabetes treatment. Analysis of covariance and Tukey-Kramer test were used to compare the BMI change during the COVID-19 pandemic based on diabetic status after adjustment for sex, age and BMI at baseline.

Result: The BMI changes in the DM group was significantly greater than in both the normal and borderline groups. The multivariable-adjusted mean of BMI change was -0.07 kg/m^2 in the normal group, 0.06 kg/m^2 in the borderline group and -0.47 kg/m^2 in DM group ($p<0.01$). Analysis stratified by overweight status at baseline showed that the change in BMI in the DM group was significantly greater than in the other 2 groups of non-overweight individuals. The multivariable-adjusted mean of BMI change was -0.14 kg/m^2 in the normal group, -0.09 kg/m^2 in the borderline group and -0.72 kg/m^2 in DM group ($p<0.01$). On the other hand, we found no significant associations in overweight individuals. However, an interaction on the association diabetic status and BMI change did not reach significance.

Conclusions: This study showed that diabetic individuals had higher BMI loss compared to normal and borderline diabetes mellitus individuals.

Keyword: diabetic, weight change, COVID-19 pandemic

PAB(T4)-12
A Meta-Analysis of the Effect of High-Amylose Rice Consumption on Postprandial Glycemic Response.

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Background and Objectives: There is a growing body of evidence on the positive effects of high-amylose rice on postprandial blood glucose levels, but it has been controversial. Therefore, in this study, we conducted a meta-analysis of the effects of high-amylose rice on postprandial blood glucose levels.

Methods: We conducted a literature search of articles published between January 1980 and October 2021 by PubMed, Google Scholar, and the Ichushi-Web (in Japanese). The search terms were high-amylose rice, blood glucose, HbA1c, glycemic index and intervention study. We further searched the references of included literatures/studies to find other relevant publications. A random effects model was used to analyze the effects of high-amylose rice on postprandial blood glucose levels.

Results: Six articles were identified for this study. Three articles showed that postprandial blood glucose levels assessed as area under the curve (AUC) or increase in AUC (IAUC) after high-amylose rice consumption was lower than those of control rice, but the other three articles did not show the significant effect. We found a significantly lower mean of AUC for high-amylose rice than that for control rice; the pooled mean difference between high-amylose rice and control rice was -844.66 min･mg/dL (95% confidence interval (95%CI) : -1367.68 to -321.64, $p = 0.002$). We also found a significantly lower mean of AUC for high-amylose rice than for control rice; the pooled mean difference was -2599.92 min･mg/dL (95%CI : -3793.03 to -1406.82, $p < 0.00001$).

Conclusions: Our findings suggested that consumption of high-amylose rice may be beneficial for postprandial glycemic control.

Keyword: high-amylose rice, postprandial glycemic control, Meta-Analysis

Conflict of Interest Disclosure: no

Further Collaborators: no

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-13
A correlation between dietary oxidative stress and secretion of hormones involved in obesity in rats

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Background and objectives: Hyperproduced reactive oxygen species (ROS) cause the oxidative stress, which could be risk factor of lifestyle-diseases developing. Recently, there are many reports related to suppression of oxidative stress, i.e., antioxidant activity of food components in vitro. However, it has not been demonstrated that whether the antioxidant effect is actually exerted after feeding of antioxidants resulting the lifestyle-diseases prevention in vivo. In this study, we investigated whether the dietary oxidative stress with feeding of diet containing fat and cholesterol leading to obesity affects oxidative stress and/or antioxidant parameters in rats. Then, we demonstrated the correlation between these parameters and hormonal secretion involved in obesity in rats, because hormonal therapy such as insulin and leptin for lifestyle-related diseases including obesity has been focused more recently.

Methods: Male Sprague-Dawley rats (5 weeks old) were purchased. After acclimation, rats were fed Control diet (commercial CE-2 powder) or FC diet containing 15% of fat and 0.5% of cholesterol prepared according to AIN-93G composition *ad libitum* for 4 weeks. Serum oxidative stress degree (d-ROMs value) and antioxidant potential (BAP value) were analyzed using with redox-analyzing instrument (REDOXLIBRA). Serum superoxide dismutase (SOD) activity, serum insulin, leptin, and adiponectin levels, serum lipid parameters, and hepatic lipid levels were measured with commercial kits.

Results: Adipose tissue weights significantly increased with feeding of FC diet. FC diet developed liver enlargement and hepatic lipid (triglyceride and cholesterol) accumulation. Hence, FC diet leading to obesity could put a load of dietary oxidative stress on rats. Dietary oxidative stress could be reflected in parameter as lowered antioxidant potential (BAP value and SOD activity), but not as heightened oxidative stress degree (d-ROMs value). Adipose tissue weights and serum insulin and leptin levels, which were increased with FC diet, indicated negative correlation with BAP value and SOD activity. On the other hand, adiponectin levels lowered with FD diet indicated positive correlation with BAP value and SOD activity.

Conclusions: These results suggested that antioxidant parameters may be able to be index of obesity and lifestyle-related diseases prevention.

Keyword: Diet containing fat and cholesterol, Dietary oxidative stress, Antioxidant potential, Hormonal secretion, Rats

PAB(T4)-14
Development of Development of “Seto Inland Sea” Dietary Ppattern and Iits Aassociation with Bbody Mmass Iindex among Japanese Individuals

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Objective: With reference to the Mediterranean diet which is one of the well-known healthy dietary pattern, we developed “Seto Inland Sea” Dietary pattern (SISD pattern) which is characterized as foods produced and culturally rooted in the area around Seto Inland Sea in Japan. Furthermore, we examined that the association between SISD pattern and body mass index (BMI).

Method: We selected the foods which had a higher production output in the area around Seto Inland Sea (Ehime, Kagawa, Hiroshima, Okayama, Yamaguchi, and Oita prefectures) based on official statistics published by the Japanese government and foods culturally rooted in the area around Seto Inland Sea. We selected 37 foods and classified them into 7 groups; fruits, vegetables, potatoes, fish, seaweeds, olive oil, and barley. To analyze the association between SISD pattern and BMI, we used body weight, height, and 7-day dietary records data from 35 borderline diabetic (pre-diabetic?)men and women from 2011 to 2012. Individuals with intake above the sex-specific median intake of each food groups were scored 1, and the sum of all food group scores was calculated as SISD pattern score. We further added the scores of non-selected vegetables and nuts intakes because higher intake of those foods could work for obesity prevention (modified SISD pattern score). We finally compared BMI between lower than median (low) and above median (high) SISD pattern score groups using analysis of covariance adjusted for sex, age, and energy intake.

Result: High score group tended to have lower BMI than low score group, the multivariable-adjusted mean of BMI was 23.07 for high score group and 24.64 for low score group (p=0.16).

High modified score group tended to have lower BMI than low score group, the multivariable-adjusted mean of BMI was 22.86 for high modified score group and 24.71 for low modified score group (p=0.10).

Conclusion: Although we observed insignificant association between SISD pattern score and BMI, modification by other foods in relation to prevention for obesity including vegetables and nuts might fortify SISD pattern against increased body weight.

Although we observed an insignificant association between SISD pattern score and BMI, modification by other foods (e.g vegetables and nuts) might strengthen the effect of SISD pattern towards obesity prevention.

Keyword: Seto Inland Sea, BMI

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-15

Effect of very low-carbohydrate diet with different protein ratio on diet-induced non-alcoholic fatty liver disease

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Background and objectives: Non-alcoholic fatty liver disease (NAFLD) is commonly found in obese population. Although studies have shown that low-carbohydrate diet can help lose weight rapidly, the effects of low-carbohydrate diet in NAFLD remains controversial and the ratio of dietary protein may also affect the effectiveness. Therefore, we aim to investigate the effects and underlying mechanisms of very low-carbohydrate diet with different protein ratio in NAFLD rats.

Methods: Rats were fed with high-fat-high-sucrose diet for 16 weeks to induce NAFLD. After the induction period, rats were divided into three groups receiving isocaloric normal diet (NC group), very low-carbohydrate diet (NKD group, protein: carbohydrate: lipid = 6:1:93) or very low-carbohydrate diet with high protein ratio (NLC group, protein: carbohydrate: lipid = 20:1:79) for 8 weeks.

Results: Although both NKD and NLC group reduced more body weight than NC group and no difference between the two groups was found at the end of the study, NLC group had lower circulatory ketone body levels. NKD group had not only higher blood and hepatic lipids, but also higher pro-inflammatory cytokines including tumor necrosis factor (TNF)-α and interleukin (IL)-1β than other two groups. Moreover, no difference in endotoxin, toll-like receptor 4 (TLR4) and myeloid differentiation primary response 88 (MyD88) was found among groups, but NKD group had higher expression in TRIF (TIR-domain-containing adapter-inducing interferon-β) than other two groups. In addition, NKD and NLC group had lower α-diversity and different gut microbiota composition when compared to NC group.

Conclusions: Our results suggested that very low-carbohydrate diet reduced body weight and led to change in gut microbiota in NAFLD rats, but high dietary protein ratio improved liver inflammation and steatosis induced by very low-carbohydrate diet.

Keyword: NAFLD, low-carbohydrate diet, protein, steatosis, inflammation

PAB(T4)-16

Brief Intervention for Treatment Adherence: a pilot study of an intervention strategy that improves nutritional adherence during weight loss treatment

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Background and objective: Obesity is a chronic disease with a high prevalence worldwide. In this regard, integral treatments are necessary to achieve better results in obesity management. Nowadays, behavior change interventions can be successful in achieving weight loss treatments; in this sense we propose the use of the Brief Intervention for Treatment Adherence (BITA) strategy for enhancing nutritional adherence to weight loss treatment in participants with obesity.

Methods: A clinical trial with a total of twenty-three subjects with obesity were included, the subjects were assigned in two study groups, group with BITA and group without BITA. They received an energy-restricted diet (20% reduction in the total energy expenditure) and the macronutrient distribution was 50% carbohydrates, 30% lipids, and 20% proteins. The nutritional intervention period was for 16 weeks.

Results: The use of BITA strategy in the intervention group significantly improved adherence to nutritional counseling *vs* participants who did not receive BITA ($p<0.05$). The patients who received BITA had greater adherence (adherence rate between 71.8 to 80%). The group with BITA showed significant improvements in weight loss (-4.9±4.0 kg weight lost), body mass index (-1.7±1.3 kg/m^2), body fat mass (-3.1±4.0 kg), and abdominal fat (-1.1±2.8%) ($p<0.05$), in comparison with the group without BITA.

Conclusions: The BITA strategy demonstrated to be useful for improving adherence to a nutritional intervention, achieving a greater weight loss.

Keyword: Nutritional adherence, behavior change, motivational interviewing, weight loss, obesity management

Conflict of Interest Disclosure: Authors declare no conflict of interest

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-17

High or low Glycaemic Index (GI) meals at dinner negatively affects glucose homeostasis compared with breakfast in people with diabetes type 2 with poor chrono-nutrition status

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Background and Objectives: Food is an external cue to entrain the circadian rhythm. Diurnal variation in glucose metabolism via circadian control is well established but how the GI of meals interacts with the timing of meals and influences glucose metabolism is understudied and crucial. The study examines the relationship between chrono-nutrition status and glucose homeostasis of people with diabetes type 2 (PWDs).

Methods: A sample size of 227(age: 35-60 years, years of diabetes :< 5, no comorbidities) was calculated considering the prevalence of diabetes in the district. Chrono-nutrition questionnaire assessed eating window, breakfast skipping, evening latency, evening eating, night eating, and largest meal of PWDs. Body composition and dietary intake were assessed using BIA and 72 hours food records. Glycaemic control was assessed using the gold standard methods- HbA1c, FBS, and PP2BS. Lipid profile was assessed. Chi-square, spearman correlation, AUC, linear regression, and multinomial logistic regression were used for statistical analysis.

Results: Fifty-two percent of PWDs reported having a poor chrono-nutrition status. A total of 4086 meals from 681 days of dietary records from 227 PWDs were studied. PWDs who followed circadian fasting rather than intermittent fasting had better glycaemic control and lower adiposity ($p<0.05$). PWDs with poor chrono-nutrition status ate twice as many carbohydrates and half as many proteins for dinner as PWDs with good chrono-nutrition status, resulting in late breakfast consumption ($p<0.05$) and a higher atherogenic index of plasma and HbA1c ($p<0.05$). Evening latency of 2-6 hours was strongly associated with controlled FBS (OR: 10, $p=0.01$). PWDs who consumed high GI meals before 10 am had better glycaemic status than PWDs who consumed high or low GI post 7 pm ($p<0.05$).

Conclusion: High or low GI meals consumed at dinner result in significantly worse glucose homeostasis than high or low GI meals consumed at breakfast by PWDs with a late eating pattern. Intermittent fasting, in which breakfast is skipped, can aid in weight loss, but circadian fasting not only aids in weight loss but also in blood glucose control.

Keyword: Chrono-nutrition, Diabetes, Meal timings, Glycaemic index, Glucose homeostasis

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T4)-18

Dietary Patterns, Cardiometabolic Indicators and Their Association with Components of Metabolic Syndrome; A Cross-Sectional Study in Polish Adults with metabolic disorders

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Background and objectives: Metabolic syndrome (MetS), characterized as a cluster of metabolic abnormalities, including central obesity, dysglycemia, elevated triglyceride (TG) levels, low high-density lipoprotein cholesterol (HDL-C) levels, and hypertension, is a major medical problem also in Poland. We investigated the associations between dietary patterns (DPs), anthropometrics parameters, cardiometabolic indicators and the number of MetS-components.

Methods: This case-control study involved 300 adults (53.1±12.9 years) from Central Poland with metabolic disorders. Data were collected with validated questionnaires (KomPAN, IPAQ). Anthropometric, blood pressure and serum concentrations of lipids and glucose were measured. MetS was defined based on the criteria of the International Diabetes Federation. Considering the number of MetS components (MetS-components) presence, the study group was divided into three groups: 0-2 MetS-components, 3 MetS-components, 4-5 MetS-components. The anthropometric obesity indexes including body mass index (BMI), waist circumference (WC), waist-height ratio (WHtR) and the cardiometabolic indicators such as visceral adiposity index (VAI), lipid accumulation product (LAP), a triglycerides-glucose index (TyG), and cardiometabolic index (CMI) were calculated. DPs were identified using *k-means* based on the 17 food groups frequency consumption. Statistical analysis was conducted in STATISTICA ver. 13.3 and included Shapiro-Wilk, Kruskal-Wallis ANOVA and $Chi^{(2)}$ test.

Results: Among the study population, 59% were women, and 52% had insufficient physical activity according to IPAQ. Only 23% of participants had normal body weight (mostly women 29% vs. 15% of men), while 25% had overweight and 48% – obesity. Significantly more men than women had more (4-5) MetS-components (68% vs. 23%). Although, the DPs were not significantly related to MetS-components groups, significant relationships were found for the lower frequency consumption of processed meats and cheese in subjects with 0-2, and 3 vs. 4-5 MetS-components. Subjects classified as having more MetS-components had significantly higher age, anthropometrics parameters (BMI, WHtR) and cardiometabolic indicators CMI, LAP and VAI.

Conclusions: In MetS management, special attention should be paid to lowering the consumption of highly processed food, especially processed meats and cheese. There is also a need to monitor the cardiometabolic and anthropometric indicators in the context of MetS risk.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Dietary patterns, anthropometrics parameters, cardiometabolic indicators, metabolic syndrome, adults

PAB(T4)-19

Evaluation of sesamin on improvement of symptoms in STZ-induced diabetes rats

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Background and objectives: Diabetes is a chronic metabolic disease. The complications such as heart disease, stroke, blindness, and kidney failure. The chemical component in sesame is lignan Lignans, mainly Sesamin, the pharmacological activities, including lowering cholesterol,anti-oxidation, anti-inflammatory, decrease blood pressure and blood sugar, immune mediation activities. In this experiment, sesamin will be used to inject Streptozotocin (STZ) + nicotinamide into rats to induce type 2 diabetes, and then sesamin will be administered to observe the changes in blood glucose of the rats.

Methods: A total of 30 male Wistar rats, six weeks old. After the rats were acclimatized for one week, divided into 5 groups. groups 2-5 were injected intraperitoneally with nicotinamide 200 mg/kg/body weigh on the 1, 15, 29 and 43 days, and then intraperitoneally injected 15 minutes later STZ 55 mg/kg/body weight. On the 8th day, groups 3 and 4 were given 20 and 60 mg/kg/body weight of sesamin by tube every day, and the 5th group was given by tube every day metformin 250 mg/kg/body weight. During the experiment, blood was collected to monitor blood glucose values. The experiment lasted for 50 days. On the 50th day, sacrificed after the end of the experiment, the blood and organs were.

Results: The blood glucose level was measured on the 8th day after STZ administration. The results showed that the blood glucose level of the STZ treatment group was significantly higher than that of the control group to 190 mg/dL ($P<0.05$). The results of blood glucose detection on 15 and 22 days were obvious, and the STZ treatment group was also significantly different from the control group. However, the blood glucose level of the STZ treatment group on the 15th day was significantly lower than that on the 8th day by 13.3% ($P<0.05$). Compared with the control group, the glycosylated hemoglobin (HbA1c) of the STZ treatment group was significantly higher than 82% ($P<0.05$).

Conclusions: Sesamin is one of the effective ingredients of sesame seeds. In this study found that sesamin can reduce blood sugar in diabetic rats. It can also provide people with effective assistance in hyperglycemia symptoms when eating sesame seeds.

Keywords: Sesamin, Diabetes, Streptozotocin, Glycosylated hemoglobin, glucose

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T4)-20

Consumption of carbohydrates, lipids and their relationship with the oxidant/antioxidant balance in patients with DMT2

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Introduction and objective: Type 2 diabetes *mellitus* (T2DM) continues to be a public health problem. The dietary intervention allows to achieve glycemic control, improve the metabolic state and therefore prevent complications. The objective of the study was to evaluate the consumption of Carbohydrates and lipids and their relationship with the modification of the oxidant/antioxidant balance in patients with DMT2.

Results: In both groups, the female sex prevailed (with DMT2 -78.7%-, without DMT2 -66%-), the mean age was 50 years for the group with T2DM and 43 years for the group without T2DM. The T2DM group consumed fewer calories (2,031 kcal/day), Carbohydrates (191 g/day), lipids (64 g/day), low concentrations of glutathione reductase (59.5 mMol), Thiobarbituric acid (TBARS: 5.6 mMol), and Total Antioxidant Capacity (TAC: 12.2 mMol), with an increase in blood glucose 152 mg/dL, Total Cholesterol (203 mg/dL), and Triglycerides (182 mg/dL). In contrast, the group without T2DM consumed more calories (2362 Kcal/day), Carbohydrates (194.2 g/day) and lipids (71 g/day), with an increase in the concentration of glutathione reductase (61.5 mMol), Thiobarbituric acid (TBARS: 5.8 mMol) and Total Antioxidant Capacity (TAC: 12.7 mMol), but a more favorable biochemical profile (Glycaemia 86 mg/dL, Total Cholesterol 186 mg/dL and Triglycerides 163 mg/dL).

Conclusions: The group with T2DM, consumed less carbohydrates and lipids, but showed lower antioxidant capacity with reduction in lipid peroxidation products, and show a damaging biochemical profile. The contrary effect shown in patients without T2DM, where is evident the diet effect and how modify and influence both biochemical and metabolic parameters.

Keywords: Antioxidants, Type 2 Diabetes Mellitus, carbohydrates, lipids

Conflict of Interest Disclosure: We don't have any conflict of interest.

Further Collaborators: Not applicable.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-21

Relevance of metformin administration to serum levels of zinc and homocysteine in patients with type 2 diabetes

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Background and objectives: We investigated relevance of metformin treatment to serum levels of zinc and total homocysteine (Hcy), an indicator of metabolic vitamin B12, in patients with type 2 diabetes (T2DM).

Methods: This cross-sectional study enrolled 138 T2DM patients (89 men and 49 women) including diabetic kidney disease (DKD). Serum concentrations of Hcy, and vitamin B12, folic acid, zinc concentration as Hcy metabolic nutrition factors, and urinary albumin excretion were measured using clinical residual samples. The laboratory data, patient characteristics, and status of medication were collected from the medical records. Next, to investigate the effects of metformin treatment, the study subjects were divided into two groups, by 1: 1 propensity score matching using age, gender, and BMI as predictors, with metformin oral administration [Met(+); n=46)] and without metformin oral administration [Met(-); n=46)], and the data were analyzed before and after the matching. Furthermore, the metformin dose (mg/day) was divided into 3 groups, and the differences were examined between the two groups using multiple comparisons after one-way analysis of variance.

Results: After matching, there was no difference in glycemic control and renal function, but urea nitrogen (UN), creatinine (Cre), and Log transformed urea albumin-to-creatinine ratio (Log UACR) in Met(-) were significantly lower than in Met (+). In addition, the serum zinc concentration (μg/dL) was significantly higher in the Met(+) (78.0 ± 12.6 vs. 86.9 ± 11.6, p <0.001), while Log Hcy was significantly lower in the Met(+) (p<0.001). Furthermore, in multiple logistic analysis with the absence or presence of metformin administration, as an explanatory variable, serum zinc concentration was associated with the metformin administration, independently of glycemic control and renal function. In addition, the Log Hcy concentration was significantly higher in Met(-) (<0.05), and the Log vitamin B12 concentration was significantly lower in the higher metformin dose group (p<0.01).

Conclusions: The present study suggests that the difference of serum zinc concentration by metformin administration were independent of renal function and metformin administration may favorably influence on serum zinc levels. In addition, these metformin treatment effects on serum Hcy or vitamin B12 concentrations were found in a dose-dependent manner.

Keywords: Zinc, Metformin, Homocysteine, DKD, T2DM

PAB(T4)-22

Effects of *Moringa oleifera* leaves on the lipid profile and heamatological parameters of type 2 diabetic subjects; a parallel group randomized clinical trial of efficacy

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Background and objectives: Diabetes has crept into the rural areas of Nigeria causing devastating effects on its sufferers; most of them could not afford diabetic medications. Moringa has been used extensively in animal models to demonstrate its antidiabetic qualities; however, there is scarcity of data on the antilipidaemic and haematinic potentials of graded levels of moringa leaves in human diabetic subjects. This study determined the effect of moringa leaves on the lipid profile and haematological parameters of type 2 diabetic subjects in a rural Nigerian community.

Methods: This study adopted a parallel group randomized control design. Participants included 24 adult male (10) and female (14) diabetic subjects who made it through the inclusion criteria and consented to participate in the study. The participants were randomly assigned to four groups (n=6), one control group and 3 experimental groups. The control group (1) was fed diets without *Moringa oleifera* leaves while the experimental groups (2, 3 and 4) received 20 g, 40 g and 60 g of moringa leaves respectively daily for fourteen days in addition to the diets. The subjects' baseline data (lipid profile, haemoglobin, packed cell volume and white blood cell count) and post intervention data were collected before and after the intervention respectively. The data obtained were analyzed using means and standard deviation, paired-samples t-test was used to compare the means of values collected pre and post intervention within the groups. Analysis of covariance was used to compare the means of post intervention values among the groups. Significance was accepted at $p < 0.05$.

Results: Groups 1 and 3 had non-significant (p> 0.05) decreases in their mean LDL cholesterol levels. There was a significant decrease in group 4's mean haemoglobin levels from “before intervention (M = 12.83, SD = 034) to “after intervention” (M =11.07, SD = 0.74) t = 5.94, P = 0.002. There was a significant difference between the post intervention values of HDL cholesterol among the groups after controlling for the pre intervention values.

Conclusion: There were marginal changes in the parameters assessed which were not dose dependent.

Keywords: Anaemia, Diabetic subjects, Lipid profile, Moringa leaves

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-23

Involvement of interleukin-21 receptor (IL-21R) in nutritionally induced nonalcoholic steatohepatitis in mice

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Background and Objectives: IL-21R has been implicated in immune functions such as lymphocyte maturation and autoimmune diseases. In this study, we analyzed the involvement of IL-21R in the development of nonalcoholic steatohepatitis (NASH) in order to investigate the life-style-related pathophysiological significance of IL-21R in the liver.

Methods: Six-week-old male C57BL/6J mice, wild-type or IL-21R deficient, were fed with a control diet or a choline-deficient, L-amino acid-defined, high-fat, trans-fat free diet (CDAA HF-T(-)) (45% fat by a shortening without trans fat, methionine 0.1%), for 4 or 13 weeks. A human hepatic stellate cell line, LX-2 was stimulated with TGF-β (10 ng/mL) or IL-21 (10, 50 ng/mL) alone or combined. Hepatic stellate cell activation was evaluated by the fibrosis-related gene expression profile and morphological changes. In addition, the effects of a TGF-β type 1 receptor inhibitor, SB431542, were assessed.

Results: In the CDAA-HF-T(-) group, liver and spleen weights, and blood alanine aminotransferase (ALT) activity were increased, and in the liver lipid accumulation, inflammation and fibrosis were developed with overexpression of IL-21and IL-21R. In the IL-21R-deficient mice, ALT elevation, liver steatosis, and inflammation were induced, but inhibited the increase of spleen weight and the development of hepatic fibrosis. In association with fibrosis, collagen type 1, 4, TGF-β type 1, and 2 gene expressions were elevated in the wild-type mice, and the upregulation of collagen type 1, type 4, and TGF-β type 2 gene expressions were suppressed in the IL-21R-deficient mice. In LX-2, TGF-β stimulation exhibited a spindle-shaped cell elongation and a network-like arrangement, and increasedαSMA protein, IL-21R gene, and fibrosis-related gene expressions, all of which were suppressed by the SB431542 pretreatment. IL-21 stimulation resulted in a slight increase in αSMA protein expression and a transient increase of collagen type 4 gene expression. Furthermore, combined administration of TGF-β and IL-21 revealed an enhanced effect on LX-2 activation.

Conclusions: In the murine NASH induced by the CDAA-HF-T(-), it is suggested that IL-21R is specifically involved in the progression of hepatic fibrosis, but not hepatic steatosis and inflammation, by at least in part to promote activation of hepatic stellate cells.

Keywords: Nonalcoholic steatohepatitis (NASH), interleukin-21 receptor, fibrosis, mice

PAB(T4)-24

Thyroid Hormone was Associated with Obesity in Adolescents aged 12 - 19 years in the United States: Data from National Health and Nutrition Examination Survey (NHANES) 2011 – 2012

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Background and objectives: Obesity is a highly complex disease that is increasing in prevalence globally. In the United States, 21.2% of adolescents aged 12 to 19 are obese. Despite its increasing prevalence, there is still much to learn about the disease. An area of controversy in obesity research has been the effect of thyroid hormones on obesity. Therefore, this study sought to investigate the relationship of thyroid hormones with obesity in adolescents in the United States.

Methods: 355 adolescents were sampled for obesity and thyroid hormone markers in the 2011 to 2012 NHANES dataset. The 2011 to 2012 NHANES dataset had the most recent information available on thyroid hormones. Percentages, frequency distributions, means (SD) were used as appropriate in describing the socio-economic and demographic characteristics of subjects, thyroid hormone markers and obesity. Multiple linear regression analysis was used to examine the relationship between obesity and independent variables.

Results: BMI was significantly associated with triiodothyronine (TT_3), thyroid stimulating hormone (TSH), family monthly poverty level, and hours spent on computer past 30 days. Waist circumference was significantly associated with TT_3, TSH, and family monthly poverty level.

Conclusions: This study showed that thyroid hormone markers were significantly associated with both obesity indicators, however, further research is warranted on a larger sample size.

Keywords: Adolescents, Obesity, Thyroid hormone, BMI, Waist circumference

Conflict of Interest Disclosure: No conflict of interest to disclose.

Further Collaborators: No.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-25

Dietary combination of sucrose and linoleic acid synergistically accumulates the intramuscular lipid and decreases the muscle strength in Zucker diabetic fatty rats

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Background and objectives: We have previously found that the dietary combination of sucrose and linoleic acid synergistically induces glucose and lipid metabolism abnormalities, endoplasmic reticulum stress, and inflammatory responses in the skeletal muscle of rats with obesity. We hypothesized that such interactions in skeletal muscle may also affect muscle function. In the present study, we examined the effects of the dietary combinations of carbohydrates and lipids on muscle mass and motor function.

Methods: Five-week-old, female Zucker diabetic fatty rats were fed experimental diets (PO, PL, SO, SL) combining palatinose (P) or sucrose (S) and oleic acid (O) or linoleic acid (L) as major carbohydrate and lipid sources, respectively, for 12 weeks. The motor functions were measured by handgrip and treadmill test.

Results: The SL group showed the synergistic decrease in grip strength compared with the other groups, but there were no differences in muscle weight or mRNA expression of MuRF-1 and Atrogin-1. Interestingly, intramuscular neutral lipids accumulation in the extensor digitorum longus (EDL) muscle, a fast-twitch muscle, was significantly increased in the SL group. Furthermore, a negative correlation was observed between the amount of intramuscular lipid in the EDL muscle and grip strength, suggesting that the SL diet promotes intramuscular lipid accumulation as well as the loss of muscle strength. We examined the expression of genes involved in intracellular uptake and accumulation of lipids and found that they were elevated not only in the SL group but also in the PL group. On the other hand, the expression of genes involved in lipolysis and fatty acid oxidation was not elevated in the SL group, but only in the PL group.

Conclusions: It can be considered that simultaneous ingestion of sucrose and linoleic acid would result in relatively higher lipid synthesis in the EDL muscle, which leads to intramuscular lipid accumulation and that could decrease muscle strength. It was suggested that the dietary combinations of carbohydrates and lipids may contribute to muscle function by differentially affecting lipid metabolism and intramuscular lipid accumulation in obesity.

Keywords: Nutritional interaction, Sucrose, Linoleic acid, Intramuscular lipid, Obesity

PAB(T4)-26

Influence of extracellular matrix deficiency on effects of vitamin E during recovery from the diet-induced NASH

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Background and objectives: Non-alcoholic steatohepatitis (NASH), a lifestyle-related diseases, is predicted to become a major cause of hepatic carcinoma in the future. In particular, hepatic fibrosis is attracting attention as a disease with extremely high unmet medical needs. We have reported that tocotrienol (T3), a vitamin E homologue, reduce inflammation and fibrosis in the early stages of a diet-induced NASH model. The effects of Vit E may be dependent on the hepatic interstitial environment, so we focused on tenascin C (TNC), which is a stromal regulator in wound healing and tumor invasion. In this study, we examined the influence of Vit E administration on the stromal environment during the recovery period from NASH and the influence of deficiency of TNC on the action of Vit E.

Methods: Wild-type (WT) and TNC knock out (TNCKO) BALB/cA male mice were divided into 4 groups, respectively, and fed a choline-deficient, L-amino acid-defined, high-fat diet for 3 weeks. The three recovery groups were fed a high fat diet (HFD), HFD containing 0.08% α-tocopherol (Toc), or 0.08% tocotrienol mixture (T3) for another 2 weeks. Blood samples were collected for biochemical analysis and liver tissues were subjected to morphological and gene expression analysis.

Results: After the recovery period, liver weight, AST and ALT levels were significantly decreased. In histological analysis, crown-like structures were prominent in WT, but less in Toc and T3 groups of TNCKO. In gene expression analysis, *Tgfb*, a major effector of fibrosis, *Pdgfb*, involved in stromal cell proliferation, migration and promotion of fibrosis, and *Vim*, a mesenchymal cell marker, were significantly decreased in Toc and T3 group of WT. In addition, *Dll4*, promotes capillarization and fibrosis, was also significantly decreased. However, *Col1a1* and *Col4a1* expression was not downregulated. In TNCKO, *Col1a1* was significantly decreased, and *Col4a1* tended to decrease during the recovery period, but no specific change was observed in the Toc and T3 groups.

Conclusions: It was suggested that Vit E and TNC deficiency may downregulate excessive fibrosis during the recovery period from NASH, respectively. Further studies are needed on the interactions among these molecules.

Keywords: Hepatic disease, extracellular matrix, vitamin E, fibrosis

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-27

GlucoTRIG: measuring the impact of high carbohydrate and high fat composite meals on postprandial insulin and triglyceride responses – a randomised controlled crossover trial protocol

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Background and objectives: GlucoTRIG is a recently developed novel index to rank the healthiness of composite meals by incorporating postprandial insulin and triglycerides responses. This study aims to examine the impact of high carbohydrate and high fat meals on postprandial insulin and triglycerides responses in humans in order to quantify and evaluate the GlucoTRIG values.

Methods: The study is a randomised controlled crossover trial including healthy adult participants (males and females, n=15). The study involves consuming three isocaloric meals (one reference meal and two test meals, Meal 1 and Meal 2) on separate visits of at least one week apart. The three meals comprise of white bread, shredded roast chicken, salad and Thousand Island dressing in different proportions. The reference meal (2001 kJ (477 kcal)) consists of 51.2% carbohydrate, 28.1% fat, 18.2% protein. Meal 1 will be a high-carbohydrate, low-fat meal (2008 kJ (478 kcal)) consisting of 71.4% carbohydrate, 9.4% fat, 17.1% protein. Meal 2 will be a low-carbohydrate, high-fat meal (2002 kJ (477 kcal)) consisting of 34.2% carbohydrate, 44.6% fat, 19.5% protein. At each visit, participants will arrive at the clinic after an overnight fast of at least 12 h. Details of physical activity questionnaire and 24-h food record will be collected. After taking a baseline blood sample at 0 min, participants will be asked to consume the meal within 20 min. Another blood sample will be taken postprandially at 180 min. GlucoTRIG value will be measured as (plasma triglycerides$_{180min}$ x plasma insulin$_{180min}$)-(plasma triglycerides$_{0min}$ x plasma insulin$_{0min}$). Study outcomes will be statistically analysed using repeated-measures analysis of variance (ANOVA, SPSS v28, IBM) and Bonferroni post-hoc test for multiple comparisons if applicable, and data presented as mean ± SEM.

Results: The GlucoTRIG value of each meal will be compared for differences in insulinaemic and lipaemic responses.

Conclusions: The study outcomes will determine if GlucoTRIG is able to detect changes in postprandial insulin and triglycerides after high carbohydrate and high fat composite meals. This project will provide further evidence for GlucoTRIG to be a physiologically relevant index for ranking the healthiness of composite meals for reducing the risk of diet-related metabolic diseases.

Keywords: Glycaemic control, glycaemic index, hyperglycaemia, hyperlipidemia, hyperinsulinemia

Conflict of Interest Disclosure: The authors declared no conflict of interest.

Further Collaborators: NA

PAB(T4)-28

Early prediction for newly-diagnosed prediabetes and type 2 diabetes using the genetic risk score and oxidative stress score

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Background and objectives: We aimed to use a genetic risk score (GRS) constructed with prediabetes and type 2 diabetes-related single nucleotide polymorphisms (SNPs) and an oxidative stress score (OSS) to construct an early-prediction model for prediabetes and type 2 diabetes (T2DM) incidence in a Korean population.

Methods: The study population included 549 prediabetes and T2DM patients (cases) and 1,036 normal subjects (controls). The GRS was constructed using six prediabetes and T2DM-related SNPs, and the OSS was composed of three recognized oxidative stress biomarkers.

Results: Among the nine SNPs, six SNPs showed significant associations with the incidence of prediabetes and T2DM. The GRS was profoundly associated with increased prediabetes and T2DM (OR = 1.946, 95% CI = 1.545–2.453) compared with individual SNPs after adjusting for age, sex, and BMI. Three oxidative stress biomarkers, namely, malondialdehyde, oxidized low-density lipoprotein, and 8-epi-prostaglandin $F_{2\alpha}$, were markedly higher in the prediabetes and T2DM group than in the normal group. The OSS was significantly associated with increased prediabetes and T2DM (OR = 2.270, 95% CI = 1.865–2.764). Through stepwise linear regression analysis, we found BMI to be the most relevant factor for increasing the risk of prediabetes and T2DM. Based on the results of a receiver operating characteristic (ROC) curve analysis, the area under the ROC curve (AUROC) improved when BMI was added to the model with the OSS and GRS (from 69.3% to 70.5%).

Conclusions: We found that in subjects with prediabetes and T2DM, the GRS and a high OSS might indicate a higher risk of prediabetes and T2DM. The prediction model composed of the OSS, GRS, and BMI showed a significant prediction ability for the incidence of prediabetes and T2DM.

Keywords: Type 2 diabetes, Prediabetes, Genetic risk score, Oxidative stress score

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

Further Collaborators: None.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-29

Circulating Adipokines and Gamma-Glutamyl Transferase As Markers Associated With Metabolic Syndrome in Mexican Children Aged 6 to 12 Years

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Background and objectives: Obesity and metabolic syndrome are prevalent diseases in children. Circulating leptin, adiponectin, tumor necrosis factor alpha (TNF-α), interleukin 6 (IL-6), and gamma-glutamyl transferase (GGT) are markers associated with cardiometabolic diseases in adults. However, there is a lack of scientific evidence in children. Identifying these markers, which are non-invasive and allow early detection of these diseases, becomes crucial. We examined the association between circulating adipokines and GGT with the metabolic syndrome in Mexican children.

Methods: The non-probabilistic sample was 140 children aged 6 to 12 from Nuevo León, México. Nutritional assessment was performed using BMI Z-score from the WHO; the criteria for metabolic syndrome for children were from the IDF. Blood samples were obtained by puncturing the antecubital vein with a 12-hour fast. Serum levels of leptin, adiponectin, TNF-α and IL-6 were measured with the Luminex® xMAP® RIA Kit, and the GGT by kinetic reaction with the Dxc Beckman Coulter equipment. A multivariate statistical analysis was carried out to identify the association with this syndrome, using Student's T-Test and Simple Linear Regression with the IBM SPSS® software.

Results: 60 children (43%) presented overweight/obesity; 33 obese children were diagnosed with metabolic syndrome (55%). Leptin showed a significant association with waist circumference (P=0.00), systolic blood pressure (P=0.00), serum glucose (P=0.02), serum triglycerides (P=0.00) and HDL cholesterol (P=0.00). Adiponectin showed a significant association with waist circumference (P=0.00), systolic blood pressure (P=0.00), serum triglycerides (P=0.00), and HDL cholesterol (P=0.00). GGT showed a significant association with waist circumference (P=0.00) and HDL cholesterol (P=0.006); IL-6 only showed a significant association with HDL cholesterol (P=0.03) and TNF-α did not show a significant association with any of the components of the metabolic syndrome.

Conclusions: The main components of the metabolic syndrome associated to leptin, adiponectin and GGT are waist circumference and HDL cholesterol. The levels of TNF-α and IL-6 did not show a significant association in children with metabolic syndrome. The study highlights the clinical importance of circulating adipokines and GGT as early markers associated with metabolic syndrome in children.

Keywords: Obese children, metabolic syndrome, adipokines, gamma-glutamyl transferase

PAB(T4)-30

Orally supplemented of N-acetylneuraminic acid regulates adipocyte function and prevents obesity

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Background and objectives: N-acetylneuramic acid (NANA), a type of sialic acid, is a component present at the end of glycan chains. Our previous study found that NANA regulates adipocyte function, and its levels have been found to reduce in adipocyte due to obesity. In the present study, we investigated the effects of exogenous NANA addition on adipocyte function, in vivo and vitro.

Methods: Male C57BL6 mice were fed a high-fat diet (HFD) containing 1% NANA for 12 weeks, followed by analysis; (1) the sialylated protein expression in adipose tissue (AT), (2) the mRNA expression of lipid metabolism related genes and antioxidant enzyme genes in AT, (3) the morphological change of AT and liver, and (4) the serum biochemical markers. To observe the direct effects of exogenous NANA addition to adipocytes, 3T3-L1 cells were cultured with 1-1000 µg / ml NANA added.

Results: NANA supplementation inhibited body weight gain and hypertrophy of epididymal ATs induced by HFD. In mRNA levels of epididymal AT, NANA attenuated the reduction of *AdipoQ* and *Sod1*, and an increase of *Fabp4* by HFD. The Increase in serum total cholesterol and free fatty acid levels, and hepatic lipid droplets induced by HFD were reduced upon NANA intake. Notably, NANA supplementation significantly increased lipid accumulation, and not affected to antioxidant enzyme gene expressions in 3T3-L1 adipocytes. NANA level was not affected by glycosyltransferase *St6gal1* gene expression and level of sialylated protein in epididymal AT and 3T3-L1 adipocytes.

Conclusions: NANA intake may prevent obesity and obesity-related disorders via suppression of adipocyte dysfunction induced by HFD. Furthermore, these phenomena may represent indirect effect of NANA supplementation on adipocytes.

Keywords: N-acetylneuraminic acid, adipocyte, obesity, 3T3-L1

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-31

Evaluation of plasma alkaline phosphatase isoenzyme as an initial diagnostic biomarker for high fructose diet-induced metabolic syndrome using rat model

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Background and objectives: High-fructose corn syrup is a liquid sugar refined from corn, potato, and other starches and consists of 50% glucose and 50% fructose. Many studies have shown that excessive fructose intake induces an increase in liver and blood triglyceride concentrations in both humans and rats and is one of the important risk factors for metabolic syndrome. Therefore, to prevent the development of metabolic syndrome from excessive fructose intake, it is necessary to know the physiological and pathological alterations that occur when excess fructose is consumed on a daily basis. In this study, rats were fed a high-fructose diet (HFD) *ad libitum* for 4 weeks to induce metabolic syndrome and the plasma hepatotoxicity markers and isozyme activities were analyzed over time to evaluate possible biomarkers that could be used for early and convenient monitoring of the effects of fructose.

Methods: Male rats were fed *ad libitum* on a 63% HFD for 4 weeks. Blood samples were taken before and every week after the start of feeding, and plasma samples were collected. The plasma samples were analyzed for hepatotoxicity markers, glycolipid system markers, and alkaline phosphatase (ALP) isozymes. After the final blood collection, autopsies were performed, and the liver, duodenum, jejunum, and ileum were collected for histopathological examination. In addition, duodenum was also used to measurement of mRNA expression for small intestinal tight junction-related protein by reverse transcription-polymerase chain reaction.

Results: As the result of feeding an HFD to the rats for 4 weeks, the livers showed increased weights, increased periportal vacuolation and macrovesicular fatty change in the hepatocytes, while the plasma lipid parameters and hepatotoxicity markers were also increased. In addition, increases in plasma liver-type ALP isozyme activities and decreases in plasma small intestinal-type ALP isozyme activities were noted soon after the start of feeding, even though total plasma ALP activity was not affected.

Conclusions: Our results clearly indicate that plasma ALP isozyme analysis could be a useful biomarker to predict the physiological effects of ingested fructose both on the liver and also on the small intestine at an early stage of the development of metabolic syndrome.

Keywords: Fructose, Metabolic syndrome, Alkaline phosphatase isozyme, Biomarker, Management of Diseases

PAB(T4)-32

Effect of Intermittent fasting on weight and glucose control in Type 2 Diabetes Mellitus patients

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Background and objectives: Numerous studies suggest that excess body weight is associated with delay the onset of Type 2 Diabetes Mellitus (T2DM). Nowadays, trend of healthy lifestyle is the global trend but the study on the effect of intermittent fasting (IF) in chronic illness like type 2 diabetes are limitation. This study was designed to investigate the relation between the blood sugar levels and the weight control by using intermittent fasting in type 2 Diabetes Meletus (T2DM) patients.

Methods: The Method of this study was under the health policy of Chon Buri province. Participants were five patients, who had diagnosis of T2DM and taking Diabetes Mellitus (DM) medicine. Participants were excluded if they had complication of T2DM, kidney disease and history of severe hypoglycemia. The three phase (baseline, intervention and follow up) observational study was designed. Participants reported their meals by photography to the online chat group throughout study stage. The fasting duration were set for participant. The self-monitored blood glucose in morning, afternoon and evening was reported twice week. The online consultation group was created for communicate between participant and the health care professional team. Every month participants were come to hospital for blood checkup and get individually nutrition intervention with dietitian.

Results: The five participants on average were overweight (Mean body mass index (BMI) 28.55kg/m^2). Average of blood glucose was decrease 36.8 mmol/dL. Three participants can reduce DM medicine. Two of all participants decrease in weight. IF led to overall spontaneous decrease in carbohydrate and caloric intake when compared with baseline as measured by food photography. Two of five participants would continue with modified IF after this study.

Conclusions: The result from this pilot study indicated that IF may improve the body weight and fasting glucose levels in T2DM. These finding should be explored for the larger and longer study.

Keywords: Intermittent fasting, Type 2 Diabetes Mellitus, Food photography, Online group consultation, Nutrition

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-33

A delayed eating schedule elevates the daily glucose level but not glycemic variability – randomized crossover study –

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Background and objectives: Skipping breakfast (BS) and late-night eating (LNE) are independently related with increased risk of type 2 diabetes. However, previous studies reported that both factors often occur at the same time (i.e., BS and LNE: delayed eating schedule) and it is also associated with metabolic syndrome. Additionally, although the influence of BS or LNE on diurnal blood glucose profiles was examined, respectively, there are no study about examining the influence of a delayed eating schedule on its. The aim of this study was to clarify the influence of eight consecutive days of "delayed eating schedule" on diurnal blood glucose profiles using continuous glucose monitors (CGM).

Methods: Eight healthy young men [mean (SD); age: 20.9 (0.8) years; BMI: 21.3 (1.8)kg/m^2; HbA1c: 21.3 (0.3)] participated in the two different feeding schedules for 8 days in a randomized crossover study. The participants were asked to start eating within the time as below; (1) Common feeding schedule (intake limited to Breakfast: 7:30-8:30, Lunch: 12:00-13:00, Dinner: 19:00-20:00) and (2) Late feeding schedule (intake limited to Lunch: 12:00-13:00, Supper: 16:30-17:30, Late-night eating: 23:00-24:00). The participants were served three meals with comparable energy and macronutrient contents during eight days in both interventions. The participants were also asked to keep sleep-wake cycles and exercise levels. At each intervention from Day 8 to 9, the experiments to assess the glucose parameters (markers of glycemic variability and levels) using the CGM (iPro2, Medtronic, Northridge, CA, USA) were performed under the highly controlled conditions in the laboratory.

Results: Glucose values of 24-h average, fasting and sleeping period were significantly higher on the Late feeding schedule compared to the Common feeding schedule ($p<0.05$). However, postprandial peak values except for breakfast, incremental area under the curve and markers of glycemic variability (MAGE: mean amplitude of glycaemic excursions and SD) were not differentially altered by the eating schedules.

Conclusions: The present study showed that delayed eating schedule elevated the average glucose level but not glycemic fluctuation. Delayed eating schedule may be part of the reason for the increased risk of diabetes.

Keywords: Late-night eating, continuous glucose monitoring system, meal timing, glucose fluctuation, randomized crossover study

PAB(T4)-34

Micronutrient deficiencies after Roux-en-Y gastric bypass versus sleeve gastrectomy in patients with obesity: A systematic review

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Background and objectives: Postoperative micronutrient deficiencies are a significant concern in bariatric surgery. Although Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) are the most prevalent bariatric surgical procedures, high-level evidence is scarce regarding the assessment of postoperative nutritional risk in RYGB versus SG. We compared the risk of micronutrient deficiencies after RYGB versus SG.

Methods: A systematic literature search was conducted for relevant studies published before Oct 25, 2021. Randomized controlled trials comparing RYGB and SG with reported incidence of postoperative micronutrient deficiencies (iron, vitamin B_{12}, or folate). The DerSimonian and Laird random-effects method was used to estimate the relative risk (RR) of postoperative micronutrient deficiencies after RYGB compared to SG.

Results: Nine randomized controlled trials involving 1160 participants were analyzed. There were no significant differences in the risk of postoperative iron deficiency (RR, 1.21; 95% CI, 0.95–1.60; *P* =.059; high level of evidence), or folate deficiency (RR, 0.69; 95% CI, 0.42–1.31; *P* =.321; moderate level of evidence). Patients undergoing RYGB had a higher risk of postoperative vitamin B_{12} deficiency than those undergoing SG (RR, 1.91; 95% CI, 1.18–2.98; *P* =.011; high level of evidence).

Conclusions: RYGB and SG have comparable risks of postoperative iron deficiency and folate deficiency. A higher risk of vitamin B_{12} deficiency was observed in RYGB than in SG, which implies that patients undergoing RYGB require more stringent vitamin B_{12} supplementation and surveillance than those undergoing SG. Healthcare professionals need to consider our findings in the assessment of postoperative nutritional risk of RYGB and SG for the appropriate selection of bariatric surgical procedures.

Keywords: Micronutrient, Bariatric surgery, Obesity

PAB(T4)-35

Effect of Whey Protein Intake after Resistance Exercise on Skeletal Muscle Mass, Strength, and Quality of Life in Older Adults with Sarcopenia: A Randomized Controlled Trial

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Background and objectives: Previous studies have not clarified the treatment of older adults with sarcopenia. This study aimed to evaluate the effectiveness of a 24-week nutritional program with whey protein intake after resistance exercise to treat older adults with sarcopenia and improve their quality of life (QOL).

Methods: Eighty-one older adults aged ≧65 years from Hyogo, Japan were included in this three–arm, stratified, randomized, open–label, parallel–group trial performed over 24-weeks. Sarcopenia was defined by the Asian Working Group for sarcopenia criteria: low hand-grip strength or slow gait speed, and low skeletal muscle mass index (SMI). The study was approved by the ethics committee of Tokushima University. The participants were allocated to one of three groups: whey protein supplementation after exercise (Ex +Whey; n=27) group, exercise (Ex; n=27) group, and whey protein supplementation (Whey; n=27) group. A 24-week program of resistance exercise was carried out twice a week. Whey protein supplementation was 11.0 g of protein and 2,300 mg of leucine. The total energy and protein intake amounts for participants in all groups were controlled to reach at least 30 kcal/kg ideal body weight/day and 1.2 g/kg ideal body weight/day, respectively, during the intervention period.

Results: After the 24-week intervention period, the Ex +Whey group had a lower prevalence of sarcopenia (pre–intervention: 100 %, post-intervention: 60.9%, $p<0.01$) and greater physical QOL scores ($p<0.05$). The prevalence of low SMI (pre–intervention: 100 %, post-intervention: 73.9%, $p<0.05$) and low grip strength (pre–intervention: 100 %, post-intervention: 69.6%, $p<0.05$) was lower in the Ex +Whey group. The Whey and Ex groups showed no decrease in the prevalence of low SMI and low grip strength and no improvement in the QOL scores. These results suggest that a combination of resistance exercise and whey protein intake in older adults with sarcopenia improves multiple outcome measures, including low SMI, low grip strength, and physical QOL.

Conclusions: We demonstrated that a 24-week intervention comprising whey protein intake and resistance exercise increased muscle mass, strength, and QOL in older adults with sarcopenia.

Keywords: Sarcopenia, Whey protein, Exercise, Quality of life, Randomized controlled trial

PAB(T4)-36

The Association of β-Carotene Intake with Mild Cognitive Impairment: the Toon Health Study

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Background: Previous researches reported that carotenoids have antioxidant effects, and oxidative stress is associated with dementia. However, there were few evidence of the association between carotenoid intake and cognitive function or dementia. Thus, we examined the association between β-carotene intake with mild cognitive impairment (MCI) for elderly Japanese men and women.

Methods: We conducted a cross-sectional study with 438 men and 723 women aged 60-84 years who participated in the Toon Health Study from 2014 to 2018. The intakes of food group and nutrient were estimated by food frequency questionnaire, and the energy intake was adjusted via residual method. We calculated the multivariable odds ratio (OR) and 95% confidential intervals (CIs) of MCI according to sex-specific quartiles of β-carotene intake after adjustment for age, sex, education level, current drinking and smoking, diabetes, hypertension, sleep duration, physical activity, and intakes of energy, vitamin E and vitamin C by logistic regression model. Furthermore, we conducted the analyses stratified by median-split vitamin C intake which has antioxidant effects.

Results: Higher β-carotene intake tended to be associated with lower odds of MCI in whole individuals. The multivariable-adjusted OR (95%CI) of MCI for the highest quartile compared to the lowest quartile was 0.72 (0.50-1.03, p for trend= 0.11). After stratification by vitamin C intake, higher β-carotene intake was associated with lower odds of MCI in individuals with low vitamin C intake; the multivariable-adjusted OR (95%CI) of MCI for the highest quartile compared to the lowest quartile was 0.11 (0.02-0.55, p for trend= 0.04).

Conclusion: In this study, we found that higher β-carotene intake was associated with lower risk of MCI in individuals with low vitamin C intake.

Keywords: MCI, carotenoid, vitamin C, antioxidant

PAB(T4)-37

Necessity and barriers of shared decision-making in nutritional dietary guidance for the elderly from the perspective of a registered dietitian

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Background and objectives: Shared decision-making (SDM) is an increasingly important process for medical providers to increase successful dietary adherence in patients, especially in older adults with chronic diseases. This study aimed to examine when dietitians feel SDM is necessary in dietary counseling, and the barriers to implementation; and to facilitate beneficial SDM for dietary counseling, especially for older patients.

Methods: From July to August 2021, an anonymous self-administered questionnaire survey was conducted online for registered dietitians engaged in dietary counseling at hospitals near the Kanto region. From the answers asked about the point of difficulty in dietary counseling for older patients, 1) situations requiring SDM and 2) barriers for implementing SDM were extracted using qualitative descriptive methods.

Results: The mean number of years of experiences among 75 participants was 12.5 (standard deviation=9.8) years, and 77.3% and 50.7% participants were engaged in metabolic diseases and malnutrition dietary counseling, respectively, at least once a week. Two categories including “Balance between dietary therapy and age, prognosis, and QOL (N=8)” were extracted for “situations requiring SDM”. “Barriers for implementing SDM” were ordered into dietitian/ organizational related factors (5 categories) and patient related factors (8 categories). One of the two categories in dietitian related factors was named “Beliefs of capabilities”, which included two subcategories, “Methods of conveying (e.g., choosing words)” and “Attention and decision processes based on patient's preference and situations (e.g., changing long-standing eating habits to maintain patient satisfaction)”. Additionally, “Health literacy (N=28)” and another seven categories were extracted as patient related factors.

Conclusions: This study suggested the need for implementation of SDM in dietary management/ restriction in dietary counseling for older patients. An approach that considers both dietitian/ organizational related factors and patient related factors when decreasing barriers is desired.

Keywords: Shared decision making, registered dietitian, qualitative study

PAB(T4)-38

Texture and sensory evaluation of whey protein jellies for nutritional care in the elderly

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Background and objectives: The elderly are at risk of undernutrition due to deterioration of swallowing function, loss of appetite with aging, and social factors. The aim of this study was to contribute to improving energy and nutrition intake in the elderly to prevent frailty and sarcopenia. We prepared protein jellies containing whey protein and examined whether they are suitable snacks for the elderly through sensory evaluation and texture measurement.

Methods: Protein jellies (orange, apple, grape, grapefruit, and pineapple flavor) were prepared as snacks and sensory evaluation was performed for appearance, taste, aroma, stickiness, smoothness, hardness, ease of swallowing, and overall evaluation in 13 female students. Two improvement plans were then made for the snacks, and the same sensory evaluation was performed in 14 female students. The textures of hardness, cohesiveness, and adhesiveness were measured using a creepmeter (RE2-3305S, Yamaden). The proportion willing to eat the jellies from the two improvement plans was investigated in 78 elderly residents of a long-term care facility.

Results: Grape-flavored protein jelly was rated worst in terms of preference. The orange-, apple-, grapefruit-, and pineapple-flavored jelly retained their aroma and acidity when protein was added, but the grape flavor had weak aroma and acidity. Two improvements plans were made to improve the taste of the grape-flavored protein jelly: (1) enhancing acidity and sweetness by adding lemon juice and sugar to grape juice and (2) sprinkling grape sauce on a lemon-flavored protein jelly. The hardness and adhesiveness of all five types of protein jellies were low, but the cohesiveness was high due to the addition of protein. Classifications of the protein jellies according to the Dysphagia Diet Pyramid ranged from Level 0 to Level 3. The proportion willing to eat the protein jellies was 95.7% for improvement plan 1 and 97.8% for improvement plan 2.

Conclusions: These results suggest that the fruit protein jellies are appropriate snacks for the elderly to take in protein from the perspectives of taste and texture.

Keywords: Elderly, Frailty, Sarcopenia, Protein, Snack

PAB(T4)-39

Inhibitory effects of tocotrienols on obesity development and obesity-related cognitive impairment

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Background: Prevalence of overweight or obesity has been increasing in not only developed countries but also developing countries, and obesity accelerates sever diseases onset and aging. Some natural compounds are focused by researchers to prevent obesity. Obesity also recognized as a risk factor of cognitive dysfunction. However, the detailed mechanisms of obesity-related cognitive impairment have not been elucidated. The elevation of brain oxidative level has been known as a cause of obesity development and cognitive decline, and calorie restriction attenuates body weight gain and accumulation of oxidative damage. From these evidences, we focused on tocotrienols (T3s), which are a part of vitamin E family and have antioxidant function, for attenuation of obesity and obesity-induced cognitive dysfunction.

Methods: C57BL/6 male mice (4 or 36 weeks of age) were fed high-fat diet (HFD) or high-fat high-sucrose diet (HFSD) in the presence or absence of T3s (10 or 50mg/100g diet) for 8 or 20 weeks. After treatment duration, the cognitive functions were measured using the Morris water maze and Rota rod test before dissection. To clear anti-obesity effect of T3s, changes in body and white adipose tissue weights, food intake volume, liver lipid droplets, serum parameters and energy metabolism were measured. Additionally, to investigate the relationship between obesity and brain oxidation, the lipid peroxide and 3-NT levels were measured.

Results: Treatment with HFD or HFSD significantly induced body weight gain compared to the controls. Additionally, treatment with T3s significantly increased energy metabolism and attenuated the increase of body weight, white adipose tissue weight, lipid droplet and serum cholesterol concentrations. The cognition of HFD-treated mice was not changed. On the other hands, the cognitions were significantly decreased, and the brain oxidation levels were significantly increased in HFSD-treated mice, and T3s significantly inhibited them.

Conclusions: This study revealed that T3s exhibit anti-obesity effects in diet-induced obesity model mice, and obesity induces cognitive dysfunction via brain oxidation, and T3s are effective for the attenuation of obesity-related cognitive decline.

Keywords: Anti-obesity, obesity-related cognitive decline, tocotrienols

PAB(T4)-40

Association between predicted body fat mass and mild cognitive impairment among community-dwelling Japanese men and women: the Toon Health Study

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Background and objectives: Recent studies reports that obesity is associated with developing dementia and mild cognitive impairment (MCI). However, few studies have reported the association between body fat mass and MCI. Therefore, the aim of present study was to examine the association between predicted body fat mass and MCI among community-dwelling Japanese men and women.

Methods: This cross-sectional study included 1,116 men and women aged 60-84 years in the Toon Health Study from 2014 to 2018. MCI was assessed by the Japanese version of Montreal Cognitive Assessment. Body fat mass was predicted by measured skinfold thickness (the back of the upper arm, lower scapula, and abdomen). Multivariate adjusted odds ratios (OR) and 95% confidence interval (CI) of MCI for sex-specific quintiles of predicted body fat mass were calculated by logistic regression models adjusted for sex, age, current drinking, smoking status, physical activity, educational status, diabetes mellitus, hypertension, and height.

Results: In this subjects, 421 participants were defined as MCI. We found that higher predicted body fat mass was associated with higher odds of MCI. The multivariable adjusted OR (95%CI) of MCI for highest quintile was 1.54 (1.01-2.36, p for trend = 0.03) compared with lowest quintile.

Conclusions: This study showed that higher predicted body fat mass may increase presence of MCI in community-dwelling Japanese men and women.

Keywords: Body fat mass, mild cognitive impairment, skinfold thickness

PAB(T4)-41

The Association Between N-3 Fatty Acids Intake and Risk of Dementia: A Systematic Review and Meta-Analysis

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Background and Objectives: Dementia refers to a collection of pathologies affecting the nervous system leading to an irreversible cognitive decline and loss of independence. Costs associated with this condition was high and cure was also

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

unavailable which necessitated an effective prevention strategy, one of which was through a nutritional approach. Previous studies found that intake of n-3 fatty acids (FA) may protect cognition, but association with dementia remained inconclusive. Therefore, we aimed to clarify the association between n-3 FA intake and dementia risk in cohort studies via systematic review and meta-analysis.

Methods: The primary exposure and outcome of interest were dietary n-3 fatty acids intake and dementia and Alzheimer's disease (AD) risk respectively. Studies were searched in PubMed, Google Scholar, and previous reviews from conception to March 2021. Inclusion criteria includes cohort study design, exposure from dietary intake of n-3 FA, and provide risk estimates and 95% confidence interval (CI) of dementia and/or AD. Pooled risk ratio was generated using random-effects model.

Result: Our search identified 9 studies fitting the inclusion criteria. The 9 studies included in the review consisted of 4 studies with dementia and AD as primary outcomes, 2 studies with dementia as primary outcome, and 3 studies with AD as primary outcome. We conducted the analysis for dementia and AD separately. Seven studies were included in the analysis for AD. Total subjects included was 446,798 with 3,410 dementia cases, of which 2,868 were AD cases. Increasing intake of n-3 FA was shown to be associated negatively with risk of dementia (pooled RR=0.75 (95% CI:0.57, 0.98), p=0.04) and AD (pooled RR=0.69 (95%CI:0.53, 0.91), p=0.008). However, we also found a significant inter-study heterogeneity (Dementia= I^2=74%, p=0.002; AD=I^2=76%, p=0.0003).

Conclusion: Considering the significant heterogeneity present in the study, it is advisable to interpret the result with caution. The present study demonstrated that increasing intake of n-3 fatty acids was negatively associated with risk of dementia and AD.

Keywords: N-3 fatty acids, Dementia , Alzheimer's disease

PAB(T4)-42

Effects of a balanced diet on blood parameters affecting bone density

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Background and objectives: Bone mineral density (BMD) deficiency and osteoporosis are common among women around the world. Different diets can provide adequate calories, but still lack various micronutrients, which also affect BMD. The aim of the study was to find out the reflection of the availability of microelements influencing women's BMD in blood analysis following the Fitlap diet, which is widely used in Estonia.

Methods: The study included adult women (excluding menopause) who followed the Fitlap diet (FDF) for at least three years and the same-aged controls who did not monitor nor restricted their diet. Participants completed questionnaire, incl. dietary recalls, which were analyzed with the Nutridata System for Research (www.nutridata.ee). Calcium, magnesium, vitamins D and B12 were measured from the fasting blood samples. Continuous data and proportions were compared by t-test and Chi-square, respectively; the influences were calculated by linear regression analyses.

Results: A total of 34 adult (22–48y) female FDF and same-aged controls were enrolled to the study. Energy consumption was similar; but FDF consumed more protein (p<0.001), fiber (p<0.001), calcium (p<0.001), and magnesium (p=0.007) than controls. The micronutrient levels of Fitlap diets in the blood did not differ significantly except for vitamin B12 (FDF *vs* controls p=0.001). The average serum vitamin D and calcium levels were mostly in accordance to reference values (50–250 nmol/L and 2.0–2.8 mmol/L, respectively) in both study groups despite the fact that, according to the menu analysis, dietary calcium intake was below the recommended intake (1000 mg/day). One FDF had calcium and 8 participants (7 controls and 1 FDF) vitamin D serum level under the recommendations. Results of regression analysis showed, that FDF are influenced to consume more fibers (coef 6.49; p<0.001) and proteins (coef 20.12; p<0.001); and it influenced also fat-free mass (coef 3674.8; p=0.008) and vitamin B12 value (coef 184.98; p<0.001). The additionally consumed magnesium decreased the magnesium (coef -0.03; p=0.05) and the intake of calcium in diet decreased the calcium value in blood (coef -0.0002; p=0.02).

Conclusion: Regular adherence to a balanced diet can benefit micronutrient intake (calcium and magnesium).

Keywords: Diet, nutrients, bone mineral density, women

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T4)-43

The association between resting energy expenditure (REE) and phase angle (PhA) in older patients hospitalized on internal medicine: A Cross-Sectional Study

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Background and objectives: The resting energy expenditure (REE) is the main part of total energy expenditure. In an older patient, better clinical outcomes may be achieved through individualized nutritional management with energy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

requirements calculated by REE. REE has been shown to decrease with aging, but the effect cannot be explained by a decline in skeletal muscle mass alone. The phase angle (PhA) can be measured using bioelectrical impedance analysis (BIA). Because the PhA has been associated with sarcopenia, nutritional status, mortality, and age, it may be a determinant of REE. Therefore, in this study, we aimed to investigate the association between REE and PhA in older hospitalized patients.

Methods: In this single–center, cross–sectional study, patients aged 70 years or older admitted to an internal medicine unit were included. REE was measured using indirect calorimetry (IC) (AE−300S) after fasting for at least 12 hours. Body composition was measured using BIA (Inbody S10) for PhA and skeletal muscle mass index (SMI). Generalized linear models were used to calculate standardized β (95% confidence interval) for REE and PhA adjusted for age, sex, and SMI. In addition, patients were classified into two groups using validated PhA cutoff values to compare the difference in REE.

Results: Totally, 110 patients were included (mean age 88.1 ± 6.7 years; 39% male). The previously reported cutoff values were used, and 53.6% of patients were classified into the low PhA group. In the generalized linear model, REE and PhA were significantly associated (0.173 [0.016, 0.330] p<0.033). Furthermore, the mean (95%CI) REEs were 884.9 (842.0, 927.8) kcal/day and 1066.6 (1021.9, 1111.3) kcal/day in the low and high PhA groups, respectively, with significant differences remaining after adjustment for age, sex, and SMI (P<0.049).

Conclusion: In older hospitalized patients, REE was associated with PhA and independently associated with body composition. Therefore, in the calculation of energy requirements, it may be necessary to consider PhA. Further research is needed to investigate the possibility that body composition and PhA may mediate the effects of aging on REE.

Keywords: Resting energy expenditure, indirect calorimetry, energy requirement, phase angle, Bioelectrical impedance

PAB(T4)-44

The improving effects of nutrition supplement drink on nutritional status in elderly with middle and high risk of malnutrition

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Background: Enough energy and protein intake can improve sarcopenia and frailty in elderly. On the other hand, around 20% of nursing home residents had malnutrition and around 50% in the high risk of malnutrition in Taiwan. Therefore, the purpose of this study is to evaluate the improving effects of nutrition supplement drink on nutritional status in elderly.

Materials and methods: This study was a randomized, parallel, multi-center clinical trial. One hundred participants with middle and high risk of malnutrition were recruited from several nursing homes in this study. Participants aged more than 65 years old were divided into two groups; one is nutritional education intervention (NE) group (n=50) and the other one is nutritional supplement drink (NSD) group (n=50), and the experimental period was 12 weeks. The participants of NE group accepted the nutritional education by dietitian. NSD group was provided with two packs of nutritional supplement drink (Mei Balance, Meiji Holdings Company, Japan) per day as a snack between meals and before bed. Body composition, muscle strength test and nutritional status and blood biomarkers were evaluated at the baseline, 6th week and the end of study.

Results: After 12 weeks of intervention, the score of the mini nutritional assessment short form (MNA-SF) and study of osteoporotic fractures (SOF) were significantly improved in NSD group when compared to the baseline. NSD group had also significantly higher body mass index (BMI) and lower 6-m usual walking speed test when compared to the baseline. There were no differences but a trend of higher body fat ratio, skeletal muscle ratio and serum albumin between baseline and the end point in NSD group.

Conclusion: In conclusion, nutrition supplement drink could significantly increase BMI and MNA-SF as well as improve physical performance such as SOF and 6-m usual walking test in elderly with middle and high risk of malnutrition.

Keywords: Malnutrition, Elderly, Nutritional supplement drink

PAB(T4)-45

Practices and Outcomes of Nutritional Support Focused on Menu Improvement in a Dementia Group Home

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Background and objectives: Dementia group homes in Japan (group homes) are not required to have a dietician or registered dietitian on staff, and the nutritional value of the meals served in many group homes is not calculated, so the quality of the menus needs to be improved. Therefore, this study aimed to examine whether nutritional support for group homes would improve the quality of menus.

Methods: The target facilities were five group homes (A, B, C: intervention facilities and D, E: non-intervention facilities). Nutritional support was provided to the intervention facilities beginning in April 2019 at a frequency of once per week for six months, including nutritional assessment of residents, advice based on the implemented menu, recipe suggestions, and joint cooking by residents and caregivers. The average daily number of foods used in the implemented menus during the month was defined as the quality of the menus. It was calculated at baseline (October 2018) before the intervention period and at endline

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(October 2019) after the intervention period and compared with and without intervention. The average number of foods per day was calculated for 14 groups (seafood, meat, eggs, milk, soy products, green and yellow vegetables, light-colored vegetables, seaweed, mushrooms, potatoes, grains, fruits, oils and fats, and confectionery) based on previous studies.

Results: There were no significant differences in residents' age, BMI, sex, and level of independence in daily living between the intervention and non-intervention facilities. There was no significant difference in the average daily number of foods used at baselines at both facilities [intervention facilities: 25.5±4.1 vs. non-intervention facilities: 25.5±2.8, *P*=0.795], however at the end line, intervention facilities were significantly higher than non-intervention facilities [intervention facilities: 26.6±4.0 vs. non-intervention facilities: 24.9±3.0, *P*=0.007]. In addition, the average daily number of foods used at the intervention facility increased significantly during the period [baseline: 25.5±4.1 to endline: 26.6±4.0, *P*=0.026], while no significant change was observed at the non-intervention facility.

Conclusions: It was suggested that six months of nutritional support at group homes could improve the average daily number of foods in the menu and improve the quality of the menu.

Keywords: Nursing home, nutrition care and management, number of foods, nursing care, sustainable

PAB(T4)-46

Effect of phosphatidylserine on cognitive function in the elderly: A systematic review and meta-analysis

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Background and objectives: Phosphatidylserine (PS), a vital component of the cerebral cortex, is involved in cognitive function. This systematic review aims to evaluate the efficacy of PS on cognitive function in the elderly.

Methods: The literature was searched in PubMed, EMBASE, Cochrane, and Web of Science, using "Phosphatidylserine" as a keyword. The present study was conducted only in literature that is a clinical study regarding humans, elderly participants, an indication of PS content, and oral administration. We screened literature by identifying the title, abstract, and full text. Selected works of literature were assessed for bias risk and quality of evidence. Randomized controlled trials were analyzed for meta-analysis. All procedures are independently carried out by two researchers.

Results: Nine articles meeting the inclusion criteria included 5 randomized controlled trials and 4 pre-post studies. The total number of participants included was 961. The dosage of PS supplementation varied from 100-300 mg/day, and the intervention period ranged from 6 weeks to 6 months. As for the risk of bias, 4 articles were rated 'some concerns', while the rest were examined to 'low'. The meta-analysis showed that PS supplementation enhanced cognitive function on memory but did not affect performing daily living activities.

Conclusions: In conclusion, PS supplementation improves cognitive function, especially within the memory domain, without side effects.

Keywords: Phosphatidylserine, cognitive function, the elderly, systematic review, meta-analysis

PAB(T4)-47

Effectiveness of Community-Based Intervention to Improve Nutritional Status and Frailty among Older Adults

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Background and Objectives: Malnutrition is a very frequent condition in the frailest groups of the population, especially in elderly subjects. Malnutrition, frailty and sarcopenia in the elderly were associated with mortality and morbidity. The aim of this study was to conduct 12-week nutrition and exercise intervention program for older adults in the community, and to analyze the proportion of malnutrition risks and the influencing factors of malnutrition in those subjects.

Methods: We recruited participants aged over 65 years old at the community center in Hsinchu city, Taiwan. After receiving their informed consent, they engaged in a 12-week nutrition-exercise intervention project. We also collected data from MNA-SF, FRAIL scale questionnaires. The physical strength was assessed by using 8-foot up-and-go test and grip strength. Dietary, physical and anthropometric assessment were also be performed and collected at 0, 12 and 24-week.

Results: Thirty-five subjects completed the project. The results of this study showed that there were 22% subjects with malnutrition risk in the beginning, 78% within normal nutrition, 17% for frailty, and 46% for pre-frail. After 12 weeks of nutrition-exercise intervention, and 12 weeks of maintenance, the risk of malnutrition was decreased to 9%. Normal, frailty and pre-frail were 92%, 6% and 34% respectively. Their nutritional status and the condition of frailty were improved, and those results did not decline after the intervention stopped. The average walking speed was increased by 0.8 s/m at 24-week compared to 0-week, and the average grip strength was no significant differences. The result was a significant increase at the 0 week and the 12 week (p<0.001). There was a significant increase at 0 week and 24 week (p<0.001). In the dietary assessment, energy and protein intakes were no significant differences.

Conclusion: Nutritional status, frailty, and walking speed were improved after nutrition education and exercise

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

interventions. On the whole, the community-based nutrition and exercise project could improve the nutritional status and frailty of the elderly.

Keywords: community , elderly, nutrition intervention, frailty

PAB(T4)-48

Making rice flour bread that contributes to the prevention and improvement of sarcopenia

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Background and objectives: Sarcopenia is characterized by an age-related decline of muscle mass and physical function (strength) that affects the quality of life. With advancing age, there is anabolic resistance and a decreasing trend of eating, leading to muscle loss. Therefore, appropriate protein intake is essential in preventing the development of sarcopenia. It is known that the amino acid leucine activates mTOR signaling more efficiently than other amino acids, affecting inhibition of autophagy (protein degradation) and leading to stimulation of protein synthesis. In addition, lysin is known to suppress protein degradation through autophagy inhibition. Also, the soy protein glycinin prevents skeletal muscle atrophy by inhibiting the ubiquitin-proteasome degradation system. Another important point in considering efficient protein synthesis is distribution across meals; however, there is a tendency for lower protein intake at breakfast. In this study, taking gluten intolerance into account, rice flour with added soy powder was utilized for efficient protein synthesis; and the effects of sub-ingredients on the quality of bread were investigated.

Methods: Breads were prepared using an automatic breadmaker. A creep meter was used to determine the rheological properties of the breadcrumbs.

Results: Compared with 100% rice flour bread, soy bread improved nutritional value and increased the amount of leucine and lysin by 2 times and 3.4 times, respectively. A slice of soy bread (70g) satisfied almost one-fifth of the daily nutritional requirement (60kg body weight). However, in terms of bread quality, the specific volume of the soy bread decreased to 70%, but recovered by 88% and 90% when adding pregelatinized rice flour and/or cornstarch instead, respectively. Also, the cornstarch improved the viscosity affected by the pregelatinized rice flour. Improvement of specific volume by pregelatinized rice flour substitution was at the fermentation level, suggesting that increased adhesiveness due to the addition of pregelatinized rice acts like gluten.

Conclusion: It can be suggested that introducing rice flour bread with added soy in one's diet is effective as part of an initiative to prevent and improve sarcopenia.

Keywords: Sarcopenia, Amino acid, Protein, Rice flour bread

PAB(T4)-49

Development of nutritional strategies within inpatient hospital menu for enhanced nutritional care of non-critical COVID-19 patients during hospital quarantine in India

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Background and Objectives: During hospital quarantine of non-critical COVID-19 patients, particular focus is given on their general management and little is known regarding the nutritional profile. The present study was therefore conducted to assess their dietary predilections during hospital quarantine.

Methods: A prospective observational study was conducted in non critical COVID -19 patients admitted in isolation wards of All India Institute of Medical Sciences (AIIMS), New Delhi from 1st November 2020 to mid of January 2021. A dietician administered a pre validated questionnaire telephonically to obtain data on demographic, anthropometric and dietary characteristics. The results were expressed as mean, standard deviation and median. Chi square tests were used to compare category variables. Statistical analysis was performed using SPSS 9 version 20.0.SPSS, Inc., Chicago IL).

Results: 132 patients volunteered to enroll in the study. The mean age of patients was 34.6 **± 13.5** years. Increase in intake of fruits, vegetables, fluids and proteins supplements was observed in majority of patients. Portion size of foods and number of food groups consumed in breakfast, lunch and dinner, did not differentiate by BMI categories (Pearson's x^2>0.05). The mean body mass Index (BMI) was 23.75 **± 4.15**. Being overweight and obese correlated with taste issues (Pearson's x^2< 0.05).

Conclusions: Owing to the new emergent COVID-19 situation, the findings of the present study may be utilized in developing the most favourable nutritional strategies within the inpatient hospital menu for providing enhanced nutritional care.

Keywords: COVID-19, hospital quarantine, nutritional strategies, nutritional care

Conflict of Interest Disclosure: none

Further Collaborators: no

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-50

In search of an easy way to help people follow dietary recommendations: the utility of diet self-monitoring using the qualitative, dietary diary Self-monitorYourDiet®

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Background and objectives: Since many people have difficulty in following dietary recommendations, there were two aims of the study: (1) to develop a qualitative, dietary diary to facilitate people's compliance with dietary recommendations by helping them in food selection and adequate food frequency consumption; (2) to test the usefulness of this diary and the possibility of ranking respondents and classifying them as those who follow dietary recommendations or not.

Methods: The dietary diary was developed as a simple, graphic-text tool based on subjects' self-monitoring their own diets named Self-monitorYourDiet®. The diary contains 11 foods, including 6 foods recommended for consumption and 5 foods with limited consumption, along with the indicated consumption frequency per day/week/month. The respondents' adherence to dietary recommendations was expressed as an Adherence Score to dietary recommendations (AdhS) in points (range 0-12). More points were awarded for better compliance with dietary recommendations. The diary was tested among 40 university students aged 20-24-years-old.

Results: Most of the participants reported that they were not burdened with the use of this diary. The fewest respondents followed dietary recommendations for vegetables and fruit in total (2%), dairy foods (8%), vegetables (12%) and fast foods (12%). More than 60% of respondents followed the dietary recommendations for legumes/nuts/seeds (88%), whole grains (72%), fruit (65%) and sweetened beverages/energy drinks (62%). The mean value of the AdhS was 4.2 points (SD 1.7), the median was 4.0 points. 15% of the sample received ≧6 points of the AdhS while no one received ≧8 points. Assuming that improving the diet (e.g. following dietetic counselling) may result in a 15–40% increase in the AdhS (e.g. from 8 to 9–11 points), an increase in the AdhS should be easily monitored within the full score range.

Conclusion: The Self-monitorYourDiet® diary can be recommended as a simple tool, easy to use for respondents. The study showed the usefulness of this diary: (1) the respondents can be ranked within range of the adherence score and classified as those who follow dietary recommendations or not, (2) to monitor changes in dietary behaviours, especially those behaviours that have been improved as a result of an intervention.

Keywords: Diet monitoring, Dietary recommendation, Diet-related diseases, Food frequency consumption, Pyramid of Healthy Nutrition

Conflict of Interest Disclosure: None

Further Collaborators: Project financially supported by the Minister of Education and Science under the program entitled "Regional Initiative of Excellence" for the years 2019-2022, Project No. 010/RID/2018/19, amount of funding 12.000.000 PLN

PAB(T4)-51

Association of Metabolic Syndrome with NAFLD- A population-based case-control study in Delhi, India

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Background and objectives: A metabolic syndrome is a group of symptoms that include glucose intolerance/insulin resistance, abdominal obesity, atherogenic dyslipidemia (low levels of HDL cholesterol and high levels of triglycerides), high blood pressure, a proinflammatory and prothrombotic state, and elevated blood pressure. Non-alcoholic fatty liver disease (NAFLD) is recognized as the most common liver disease, affecting one-quarter of the world's population and frequently associated with metabolic illnesses such as type 2 diabetes, hypertension, obesity, and cardiovascular disease. NAFLD is characterized by an increase in liver fat content in the absence of a secondary cause of steatosis. The present study was planned as a case-control study to investigate the association of metabolic syndrome with NAFLD.

Methods: A community-based case-control study was conducted amongst 268 age and gender-matched males and females aged 30-60 years residing in DELHI-NCR. Participants with grade II and III fatty liver, based on USG grading were enrolled as cases while participants with normal liver were enrolled as controls. Anthropometric and biochemical assessments were done and metabolic syndrome was diagnosed based on NCEP-ATP-III (2005 revised) criteria.

Results: The metabolic syndrome was significantly more prevalent in cases (86%) as compared to controls (50%) (p=0.000). Out of 5 metabolic parameters, significantly higher derangements were seen in cases versus controls on waist circumference (cases=69%, controls=28%, p=0.000); fasting blood glucose (cases=97%, controls=88%, p=0.009), and serum triglycerides levels (cases=58%, controls=31%, p=0.000). The two groups were statistically different on prevalence of any 4 criteria (cases=40%, controls=16%, p=0.000) or all five criteria (cases=12%, controls=4%, p=0.012).

Conclusions: Hence, patients with NAFLD are more likely to develop metabolic syndrome, which raises their risk of

developing cardiometabolic disorders such as Obesity, Diabetes, Hyperlipidaemia, and Hypertension. Hence it is imperative that individual metabolic risk factors be timely diagnosed and treated in these patients.

Keywords: Non-alcoholic fatty liver disease , Metabolic syndrome, Diabetes , Hyperlipidaemia, Hypertension

Conflict of Interest Disclosure: Authors have no conflict of interest

PAB(T4)-52
Dietary antioxidant indices and their association with cardiac disease: Baseline analysis of Kharameh cohort

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Background and objectives: Oxidative stress contributes to the development of cardiovascular disease. Tools for evaluating the anti-inflammatory and antioxidative characteristics of an individual's diet as a whole may be valuable for assessing the combined effects of dietary antioxidants on health. This population-based study aimed to investigate the association between dietary antioxidants and cardiac disease.

Methods: In this population based cross-sectional study, 10439 individuals aged 40-70 years were recruited during 2014-2017 in Kherameh cohort study which is a part of the Prospective Epidemiological Research Studies in Iran (PERSIAN). The food frequency questionnaire (FFQ) with 130 food items was used to assess the dietary intakes. Vitamin A, E, C, selenium, zinc and Manganese intakes were used to compute dietary antioxidant index (DAI) and dietary antioxidant quality score (DAQs).

Results: The participants' mean age was 52.1 years. Among all, 4356 (41.7 percent) were overweight and 1892 (18.1 percent) were obese. According to the results, odds of cardiac diseases decreased by increasing DAI score. Odds of cardiac diseases increased by lower DAQS after adjusting for demographic variables including age, sex, BMI, Marital status and hypertension.

Conclusion: The role of antioxidants in reducing the odds of cardiovascular disease is very important. Our results highlighted that DAQS and DAI had protective effect on the odds of cardiovascular disease by 20 and 21 times. Therefore, it is suggested that antioxidants as zinc, manganese, selenium, and vitamins A, E and C should be taken through food to reduce the risk of the disease.

Keywords: Antioxidants, Cardiac disease, Dietary antioxidant index, Dietary antioxidant quality, Dietary intake

PAB(T4)-53
Symptoms and nutritional counseling needs of patients with psychiatry disorder

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Background and objectives: Psychiatric disorders tend to be chronic. There are concerns about the development of dyslipidemia and diabetes due to side effects of medication and decreased activity. In our previous study using the Hospital Anxiety and Depression Scale (HADS), we found that patients with high anxiety desired nutritional counseling. In the present study, we investigated the symptoms and nutritional counseling needs of patients with psychiatric disorders.

Methods: We examined body composition, blood tests, symptoms, anxiety and depression, and assessed nutritional counseling needs among hospitalized patients with psychiatric disorders. Written consent was obtained. Statistical analysis was performed using SPSS 28 and the χ^2 test. Ethical review number was ONR-0005 and clinical trial number was UMIN 000037178.

Results: The study was carried out prospectively from August in 2019 to April in 2020. The mean age of patients was 58.0 (± 13.4) years. We found that patients (n = 67) with a body mass index (BMI) of less than 18.5 kg/m^2 or more than 25 kg/m^2 tended to request more nutritional counseling than those with a normal BMI (p= 0.092). Among the symptoms, those with diarrhea (p= 0.013), abnormal sense of smell (p = 0.029), and pain (p = 0.007) requested nutritional counseling; however, there were no significant associations with anorexia, excess appetite, nausea, constipation, stomatitis, taste abnormalities, or fatigue.

Conclusions: Patients with psychiatric disorders were more concerned about BMI and may have higher nutritional counseling needs. In addition, patients with diarrhea, olfactory abnormalities, and pain requested nutritional counseling, suggesting that nutritional support in psychiatry needs to be examined by a multidisciplinary team. Patients with psychiatric disorders are at multiple risks for hypo- or overnutrition including decreased activity, side effects of medications, and psychosocial factors. Therefore, it is important to determine the needs of individual patients and to take a multidisciplinary approach.

Keywords: Psychiatry disorders, Nutritional counseling, Symptoms, Body mass index

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-54
The role of intestinal Cytochrome P450 in vitamin D metabolism

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Background and objectives: Physiological vitamin D status is important for bone health. Vitamin D hydroxylation in the liver/kidney results in conversion to its physiologically active form of "1,25-dihydroxyvitamin D" (1,25D). 1,25D controls gene expression through the nuclear vitamin D receptor (VDR) mainly expressed in intestinal epithelial. Activation of VDR by 1,25D binding results in heterodimerization with the retinoid X receptor (RXR) and association with vitamin D responsive elements (VDREs) in the promoter region of vitamin D target genes. Cytochrome P450 (CYP) 24A1 is a catabolic enzyme expressed in kidney that is important for 1,25D inactivation and maintaining 1,25D homeostasis. Interestingly, a recently identified mutation in CYP3A4 (gain of function) caused vitamin D-dependent rickets, type III. Unlike CYP24A1, CYP3A4 is mainly expressed in liver and is a known xenobiotic enzyme. CYP3A4 has been reported to convert 25-hydroxyvitamin D to 4beta,25-dihydroxyvitamin D, in vitro. The CYP3A family in humans (3A4, 3A5, and 3A7) possesses high amino acid homology. These CYP3As and CYP24A1 are also expressed in intestine, but their hydroxylation activities towards vitamin D substrates are unknown.

Methods: We constructed human CYP3A4, 3A5, 3A7 and 24A1 expression plasmids, and evaluated their CYP activities on vitamin D action using VDRE-transcriptional assays, mammalian two-hybrid assay (VDR-RXR), or real-time PCR in human colon cultured cells. Moreover, we examined the expression level of CYPs in the intestine, kidney or liver from mouse by real-time PCR or western blotting.

Results: Expression of CYP3A4, 3A5, 3A7, and 24A1 all significantly reduced 1,25D-VDRE activity in HCT116. Moreover, CYP3A4, 3A5, and 3A7 significantly reduced VDR-RXR interaction/heterodimerization. In C2BBe1 cells, CYP3A4 also inhibited 1,25D-mediated induction of Transient Receptor Potential Vanilloid (TRPV6), a membrane calcium channel which is involved in Ca^{2+} absorption in the intestine. Finally, in mice, Cyp3a mRNA or protein was more expressed than Cyp24a1 in the intestine.

Conclusions: Therefore, CYP3As attenuate 1,25D action in intestine, and CYP3A inducers like phenytoin or phenobarbital, carbamazepine (anti-epileptic medicines), pioglitazone (hypoglycemic medicine), etc. could compete with vitamin D treatment in osteoporosis patients. Further studies are needed to clarify the physiological role of intestinal CYP3A and/or CYP24A1 in metabolism of 1,25D, in vivo.

Keywords: Cytochrome P450, 1,25-dihydroxyvitamin D, Intestine

PAB(T4)-55
Differences in urinary phosphorus excretion after animal or plant protein intake in healthy young Japanese women : An additional study by unifying dietary content

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Background and objectives: We have previously reported the effects of protein intake and sources (animal or plant protein) on phosphorus excretion as a preliminary evaluation to prevent hyperphosphatemia and a diet therapy for chronic kidney disease (CKD) dialysis patients. However, in the above study, dietary content and intake were at the discretion of each subject, resulting in varied intakes of food ingredients, energy, and nutrients. Therefore, we conducted an additional study by unifying the dietary content for each diet group in this study.

Methods: Healthy young Japanese women were divided into three groups: animal protein meal intake group (animal), plant protein meal intake group (plant), and protein restriction meal group (low-protein), and were subjected to a 2-day dietary intervention. Amount of nutrition and menu planning were referred to the Dietary Reference Intakes for Japanese (DRIs) and adjusted for energy, fat, and carbohydrate within the target range. Protein was adjusted to the target range (1.2-1.4 g/kg) in the animal and plant, and half value (0.6-0.7 g/kg) in the low-protein group. The nutrients of the intervention diet were analyzed using the duplicate method, and the intake of each subject was calculated individually based on the dietary records (leftover weight) and photographs. Urine was collected before and after dietary intervention, then analyzed.

Results: There were no significant differences in the urinary urea nitrogen (U-UN), which indicates protein excretion, and urinary phosphorus (U-Pi) among the three groups on pre-intervention. However, after the intervention, U-Pi was significantly lower in the plant group than in the animal group, despite no significant difference in the U-UN; its excretion was at similar levels to the low-protein group.

Conclusions: In this study, as a result of unifying the dietary content for each group, we showed that the plant group reduced urinary phosphorus excretion to levels similar to that of the protein-restricted diet. Nevertheless, the protein intake was comparable to that of the animal protein diet. It supported our previous research.

Keywords: Urinary phosphorus, plant protein, animal protein

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-56
At-risk of malnutrition is strongly associated when older patients discontinued home-medical cares: A 1-year follow-up study

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Background and objectives: Malnutrition and at-risk of malnutrition (i.e. potential risk of malnutrition) are both prevalent among older patients receiving home-medical cares. Discontinuation of home-medical cares often happens when an older patient was admitted to a hospital, a nursing home or reporting death. Thus, the aim of this study was to assess prospective associations between nutritional status and discontinuation of home-medical cares in older patients.

Methods: This prospective study was conducted in Nishinomiya city, Hyogo Prefecture, Japan. Three hundred and thirty-three community-dwelling older patients (aged 65 years or older who were receiving home-visit nursing care services) were included in this study. Their nutritional status was assessed using the Mini Nutritional Assessment®-Short Form (MNA®-SF) and patients were classified into three groups (Well-nourished, At-risk of malnutrition and Malnourished). Outcomes were confirmed at one-year follow-up. Hazard ratios (HRs) and 95% confidence intervals (CIs) for discontinuation of home-medical cares of nutritional status were calculated using a cox proportional hazard model. Covariates included age, sex, living status, economic status, activity of daily living, comorbidity, and dysphagia status.

Results: A total of 297 patients (63.0% women; median age: 84 years) were analyzed. At baseline, 48.5% of patients were at-risk of malnutrition and 18.9% were malnourished. During the observation period of one year, 82 (27.6%) patients were discontinued home-medical cares. In adjusted model, HR for discontinuation of home-medical cares in the At-risk of malnutrition was 2.44 (95% CI: 1.34-4.45; p=0.003) times the Well-nourished. Although the Malnourished was significantly associated with discontinuation of home-medical cares (HR 2.21, 95%CI: 1.11-4.38; p=0.023) in crude analysis, was not significantly associated in multivariate analysis (HR 1.69, 95% CI: 0.77-3.72; p=0.189; referent: the Well-nourished).

Conclusions: At-risk of malnutrition was associated with discontinuation of home-medical cares among older patients. Our study suggests the need to strengthen nutritional strategies, such as providing individualized dietary counselling for older patients. Then, they may be able to continue receiving medical cares at their home, instead of starting them at hospital or nursing home.

Keywords: Malnutrition, home-medical care, older patients, Mini Nutritional Assessment®-Short Form

PAB(T4)-57
The Association between Rice Intake and Snoring: the Toon Health Study

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Background and objectives: Snoring is one of the symptoms of sleep apnea and is associated with various health problems such as hypertension, diabetes and coronary heart diseases. Prevention for snoring is important, but few studies have examined the preventive factors, in particular dietary factors, for snoring. Thus, we aimed to examine the association between rice, which is the major staple food for of Japanese, and snoring.

Methods: This cross-sectional study included 2032 Japanese men and women aged 30 to 79 years who participated in the Toon Health Study. Snoring was assessed by a part of Berlin Questionnaire, and we defined snoring as the occurrence of snoring >1 times a week The amount of rice intake was assessed by food frequency questionnaire, and adjusted for energy intake using residual method. The participants were divided into sex-specific quartiles according to rice intake. The multivariable-adjusted odds ratio (OR) and 95% confidence intervals (95%CIs) of the presence of snoring for the quartiles of rice intake was calculated using logistic regression after adjustment for age, sex, physical activity, current smoking, current drinking, body mass index, energy intake and sleep duration. We also performed a stratified analysis by current drinking status which was strongly associated with snoring.

Results: We found an insignificant association between rice intake and snoring in men and women; the OR (95%CIs) for the highest quartile compared to the lowest was 0.80 (95%CI:0.52-1.23, p for trend=0.25) in men, and 0.86 (95%CI:0.60-1.25, p for trend=0.57) in women, respectively. After stratification by current drinking status, we found that the OR for the highest quartile was significantly lower than that for the lowest in women with current drinking; the OR (95%CIs) is 0.51 (0.28-0.95, p for trend=0.08). This association remained significant after further adjustment for ethanol intake. We found an insignificant association between rice intake and snoring in men and nondrinking women.

Conclusions: In conclusion, higher rice intake tended to be associated with lower presence of snoring among Japanese women with drinking habit.

Keywords: Snoring, rice intake, drinking

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-58
Curcumin suppresses cancer metastasis by inducing anoikis in cancer cells

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Background and objective: Cancer metastasis is one of main cancer complications resulting in poor patient outcomes. The metastatic potential of cancer cells has a strong relationship with anti-anoikis ability obtained by undergoing epithelial-mesenchymal transition (EMT). Since the induction of anoikis in cancer cells may be an effective means of preventing the metastasis of tumors, we examined the inhibitory effect of curcumin on anchorage-independent growth, leading to anoikis in cancer cells. Curcumin, a naturally occurring polyphenol extract, has been extensively studied for its anticancer properties. In this study, we focused on a critical role of 14-3-3 protein family in anoikis suppression because our previous data has indicated that its down-regulation by curcumin *in vitro* induces the apoptosis in A549 cells. Furthermore, we found that curcumin prevents the metastasis of lung cancer cells using mouse lunge carcinoma cells and allograft model *in vivo*.

Methods: To induce anoikis under anchorage-independent conditions, mouse Lewis Lung Carcinoma (LLC) were plated in an ultra-low attachment 96-well plate and curcumin was added to the medium at indicated concentrations. Cell viability was quantitatively measured by using WST-8 assay. Events linked to metastasis were evaluated by immunoblotting using extract from LLC. Cell migrations was evaluated by using 24-well transwell plates with 8.0 μm pore polycarbonate membrane inserts. After incubation, migratory cells were fixed with PFA and stained with crystal violet. An animal experiments were performed to determine whether localized treatment of subcutaneously growing LLC in C57BL/6 mice with intraperitoneal injection of curcumin affects the formation of distant metastasis.

Results: Curcumin inhibited the proliferation of A549 and LLC cells cultured in non-adherent condition by suppressing 14-3-3 β and γ. We also found that curcumin significantly inhibits LLC migration by using boyden chamber assay. On the other hands, *in vivo* analysis showed a significant decrease in the number of metastases in the lung of the curcumin-treated groups as compared with them of control. These observations indicate that curcumin inhibits cancer metastasis by inducing anoikis in LLCs and decreasing their cell migration ability.

Conclusion: Our results suggest that curcumin reduces the survival rate of cancer cells cultured in non-adherent condition and inhibits their migration, which may be responsible for the ability of curcumin to suppress metastasis *in vivo*. These findings may contribute toward the development of new and less toxic chemotherapies that use natural compounds against cancer metastasis.

Keywords: Cancer, EMT, polyphenol

PAB(T4)-59
Hypertension and associated risk factors among community-dwelling rural adults in abia state, Nigeria

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Background and objective: Hypertension is a growing public health problem in developing countries contributing to morbidity and mortality of billions of adults worldwide. The study aimed to assess the prevalence and factors associated with hypertension among adults in rural communities of Ikwuano, Abia State, Nigeria.

Methods: The study was a community-based descriptive cross-sectional survey conducted among 429 apparently healthy rural adults aged 20 to 59 years using cluster sampling technique. Socio-demographic information was obtained using a validated questionnaire. Blood pressure and anthropometric measurements were carried out following standard procedures. Hypertension was defined as systolic blood pressure (SBP) equal or greater than 140mmHg and/or diastolic BP (DBP) equal or greater than 90mmHg. Logistic regression analysis was used to assess risk factors associated with hypertension.

Results: The prevalence of hypertension was 51.0% (58.1% in males and 43.1% in females). Hypertension was significantly associated with age, gender, marital status and BMI. In the adjusted model, older age (>40 years) (OR=1.96; 95% CL1.03 to 3.72; p<0.04) and overweight/obesity (OR=2.55; 95% CL1.50 to 4.34; p<0.001) were associated with higher odds of having hypertension. Female gender was associated with lower odds of hypertension compared to males (OR=0.32; 95% CI 0.20 to 0.52; p<0.001).

Conclusion: The study showed a high prevalence of hypertension among rural community-dwelling adults, underscoring the need for routine screening of adults for early hypertension diagnosis.

Keywords: Hypertension, Risk factors, Adults, Rural, Prevalence

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-60
Hesperetin attenuates cancer stemness properties by down-regulating the expression of heat shock factor 1 in non-small lung cancer cells

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Background and objectives: Cancer stem cells (CSCs) have explained many cancer complications, including cancer recurrence, metastasis to distant organs, and multiple drug resistance. Therefore, current methods for the treatment of cancer are being investigated, which can target CSCs. While resistance to chemotherapy treatments is commonly associated with CSCs population, natural products, such as food components, have been a rich source of biologically active compounds for the pharmaceutical industry. In this study, we examined the effects of hesperetin on CSCs. Hesperetin, a predominant flavonoid found in citrus fruits, has received considerable attention in potential anti-cancer activity. To address the mechanisms of hesperetin targeting CSCs, we focused on the function of heat shock factor 1 (HSF1), a transcriptional regulator of heat shock proteins, because accumulated data have shown its important role in regulating the expression of cancer stemness-related factors.

Methods: Fluorescence-activated cell sorting (FACS) was used to measure the CSCs surface marker CD133(+) subpopulation in the non-small cell lung cancer cells A549. The effect of hesperetin on the self-renewal ability of A549 cells was examined using sphere-formation assays. Real-time PCR, Western blot, and immunofluorescence assays were used to evaluate the expression of HSF1 and cancer stemness-related factors. RNA interference was used for mechanistic studies. Wound healing assays and transwell assays were used for migration and invasion, respectively.

Results: Hesperetin reduced the number of CD133(+) cells, whereas cisplatin did not affect the number of CD133(+) cells in A549. Hesperetin also decreased the number of sphere formations. On the other hand, we found that hesperetin inhibited the expression of HSF1 in A549. Furthermore, the decreased number of spheres caused by the depletion of HSF1 by RNA interference is evidence that the inhibitory function of hesperetin on sphere formation is mediated by its effect on HSF1. Wound healing and transwell assays demonstrated that hesperetin suppresses migration and invasion ability in A549. In the present study, we also found that hesperetin inhibits the expression of self-renewal-related genes and epithelial-mesenchymal transition (EMT) marker genes via suppression of HSF1 expression.

Conclusions: We found that hesperetin suppresses cancer stemness related to metastasis and recurrence by suppressing HSF1 expression. Hesperetin, therefore, may be a key product to discovering a novel treatment demanded by the difficulty of targeting CSCs.

Keywords: Hesperetin, cancer stem cell, HSF1

PAB(T4)-61
The effects of factors related to muscle flexibility, joint laxity, and dietary habits on sports injuries and trauma

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Background and objectives: Sports injuries and trauma vary depending on the type of sporting event, age, and sex. Athletes are likely to develop stress-induced fractures due to accumulated daily fatigue, poor dietary habits, and lack of nutrients. This study aimed to examine sports injuries and trauma associated with muscle flexibility, joint laxity, and dietary habits and investigate factors affecting sports injuries and trauma.

Methods: Twenty male athletes participated in this study. We measured the speed of sound (SOS) and broadband ultrasound attenuation (BUA) as an index of calcaneus bone mineral density. Nutrient intake was assessed using a food frequency questionnaire (FFQg). Food intake and eating habits related to bone health were investigated using the calcium self-checklist of the Japan Osteoporosis Society. We evaluated muscle flexibility and joint laxity scores as described in previous studies. Participants' history of fractures, sprains, and overuse syndromes was obtained.

Results: There was a significant positive correlation between muscle flexibility and joint laxity scores. However, there was no correlation between SOS, BUA, and nutrient intake assessed using FFQg and the frequency of fractures. In addition, there was no significant correlation between calcium intake assessed using FFQg and the calcium self-checklist score. We examined the differences in joint laxity and muscle flexibility scores according to experiences of fractures, sprains, or overuse syndromes, and we found a significant difference between fracture experience and the muscle flexibility score. The regression analysis results showed that the muscle flexibility score, but not the joint laxity score, was an important predictor of the presence or absence of fracture experience.

Conclusions: The effects of muscle flexibility on fractures were confirmed, but that of joint laxity on fractures were not established. The frequency of fractures did not correlate with SOS, BUA, and calcium intake assessed using FFQg. Further research is needed to assess whole body bone mineral density and perform a detailed dietary survey.

Keywords: Bone mineral density, food frequency questionnaire, bone fracture, sprain, overuse syndrome

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-62
Intestinal microbes-derived hydrogen molecules in pregnant rats or mice fed fructooligosaccharide-containing diet, permeates into fetus and affects the oxidative stress

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Background and objectives: The nutritional environment during fetal life is considered to affect the risk factors of life style-relates diseases, asthma or allergy during developmental or adulthood periods. Nondigestible saccharides are recognized as a food component, metabolized by host intestinal microbes, and produce molecular hydrogen and short chain fatty acids *etc*. Intestinal microbes-derived hydrogen molecules (IMDH) transfers to peripheral tissues by blood circulation and regulates oxidative stress. In this study, we investigated whether IMDH of pregnant rats or mice fed with fructooligosaccharide (FOS)-containing diets permeates into the fetus and affects oxidative stress.

Methods: Female Wistar rats (n=5, CLEA Japan, Inc., Tokyo) and C57BL/6J mice (n=6, Japan SLC, Inc., Tokyo) on the first day of gestation were divided into two groups: CONT group fed AIN-93G and 5% FOS group replace with FOS for a half of sucrose in AIN-93G. On the 18th day of gestation, after the animals were dissected, blood, organs, tissues, and fetuses were collected, and prepared to measure the free IMDH. IMDH was measured using Breath Gas Analyzer BGA1000D (Research Institute of Expiration, Nutrition and Metabolism, Nara, Japan). Parameter of oxidative stress were measured by real time RT-PCR.

Results: In pregnant rats, IMDH in blood, uterus, liver, and perirenal adipose tissue in FOS group were significantly higher than those in CONT group (p<0.05). IMDH was also detected in other organs except heart and muscle, but no statistically significant difference was observed. In pregnant mice, IMDH in FOS group was also significantly higher than in CONT group (p<0.05). In the fetuses of both rats and mice, IMDH in FOS group showed significantly higher values than that in CONT group (p<0.05). The parameters of oxidative stress were affected by the feeding of FOS.

Conclusions: This is the first finding that IMDH in pregnancy by the feeding of FOS transfer to the fetus via blood stream in rats and mice. We believe that IMDH by the intake of nondigestible saccharide in pregnancy could reveal the beneficial functions equivalent to the external IMDH for the mother and their fetuses.

Keywords: fructooligosaccharide, intestinal microbes-derived hydrogen molecules (IMDH), pregnant, fetus

Conflict of Interest Disclosure: The authors thank Meiji Co., Ltd. for providing fructooligosaccharide.

PAB(T4)-63
Learning from the community to predict Nutrition Status of Children aged 6-24 months in Gulu District, Northern Uganda. A Matched Case-Control Study

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Background and objectives: In the last two decades, most health indicators for Ugandan children have improved. However, the prevalence of undernutrition is still of public health concern. Most of the nutrition studies have focused on unfavorable factors that contribute to malnutrition rather than on the favorable factors that promote good nutrition status among children. This study aimed at identifying factors and practices of mothers/ caregivers associated with better nutritional outcomes for their children aged six to 24 months compared to mothers/ caretakers of children with poor nutritional outcomes living in the same neighborhood.

Methods: This was a case-control study conducted in Gulu district on 300 (i.e.,100 cases and 200 controls) purposively selected sample of children in the age group of 6- 24 months. Controls were children of normal nutrition status with WAZ, HAZ and WHZ ≧-2 Z-scores. Cases were undernourished children 6 to 24 months of age with at least one of the indices WAZ, HAZ or WHZ <−2 Z-scores. Quantitative data was collected using a semi-structured questionnaire. Logistic regression was used at bivariable and multivariable analysis to determine the predictors of good nutrition status using Odds ratios (ORs) as the measure of association. Both the crude (COR) and adjusted odds ratios (AOR) were reported. A p-value less than 0.05 was considered statistically significant at 95% confidence interval.

Results: The mean age of the cases and controls was 15 months (SD ㊧ 6) and 13 months (SD ㊧ 5), respectively. At multivariable analysis, breastfeeding in the first hour of child's life (AOR=3.31 95%CI. 1.52, 7.23), use of family planning (AOR=2.21 95% CI. 1.25, 3.90), less number of under-fives in the household (AOR=0.31 95%CI. 0.13, 0.73) and handwashing with soap (AOR=3.63 95%CI. 1.76, 7.49) were significantly independently associated with child's optimal anthropometric nutrition status.

Conclusion: Interventions that could improve children's nutrition status include; breastfeeding in the first hour of child's life, use of family planning methods, child spacing and handwashing with soap.

Keywords: Nutrition Status, Community, Care givers, case control

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: N/A

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-64
Influence of body shape perception on body mass index and nutritional status in female patients with pulmonary nontuberculous mycobacterial lung disease

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Background and objectives: Pulmonary nontuberculous mycobacterial lung disease (NTM-LD) is a chronic respiratory infection that occurs more commonly in thinner women. The lower body mass index (BMI), the worse the prognosis though, some patients are resistant to enough food intake and weight gain. We therefore hypothesized that female NTM-LD patients may overestimate their body shape like ordinary women. To confirm the hypothesis, we examined the influence of body shape perception (BSP) on BMI and nutritional status in female patients with NTM-LD.

Methods: Eighty-one female outpatients were included. As control, we used web survey data obtained from 111 ordinary women. BSP were evaluated using Japanese version of Body Image Scale. Participants identified the silhouette that best represented their own body (perceived silhouette). The silhouette number corresponding to patient's BMI is defined as actual silhouette, and body image distortion was calculated as the difference between perceived and actual silhouette. Body composition, dietary intake, appetite, and biochemical markers were examined during the hospital visits. First, BSP and BMI were compared between all patients and controls. Next, the data obtained from the patients were compared between underestimated-matched and overestimated groups.

Results: Patients had a significantly lower BMI than control (19.8±2.5 vs 22.4±3.2 kg/m^2, p<0.001), but 31 (38.3%) patients overestimated their body shape. In inter-patient comparisons, the overestimated group had a significantly lower BMI and body fat percentage (p<0.001, respectively), significantly larger weight loss since age 20 or their maximum weight (p=0.003, 0.016, respectively), and a trend toward lower protein intake and lymphocyte count compared to the underestimated-matched group. There was a negative correlation between body image distortion and BMI (r=−0.457, p<0.001). Multiple regression analysis revealed that body image distortion (β=−0.463, p<0.001) was independently related to BMI (R=0.568, p<0.001).

Conclusions: Despite remarkable thinness, approximately 40% of the patients overestimated their body shape, and such overestimation may be associated with low BMI and weight loss. These results suggest that to prevent and improve thinness in NTM-LD patients, it is necessary to provide adequate nutritional intake as well as guidance to understand and correct patients' perception of their body shape.

Keywords: nontuberculous mycobacteria, women, body shape, distortion, thinness

PAB(T4)-65
Effects of dietary fatty acids on high-density lipoprotein proteomic profile and quality

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Background and objectives: High-density lipoproteins (HDLs) are circulating particles that carry out cholesterol efflux and anti-inflammatory and antioxidant functions which are determined by HDL composition. However, HDLs have been described to turn into pro-inflammatory and non-functional particles in pathological conditions, and different studies suggest that lifestyle factors, such as diet, could also alter HDL functionality. The aim of this study was to report the influence of the intake of dietary fatty acids from different sources on HDL proteome and functionality.

Methods: Forty subjects were allocated in two groups: normal-weight and metabolic syndrome. Anthropometric data and blood were collected after 12 h of fasting. Additionally, five healthy volunteers were recruited for an interventional study with different dietary fatty acids. Four different times, the volunteers were cited and asked to take a fat-rich (poly-unsaturated, mono-unsaturated, or saturated fatty acids) or no-fat emulsion. At Baseline, 2.5 h and 5 h after they took the emulsion, blood was collected. Blood was centrifuged and serum and plasma were stored at -20 °C until analysis. Biochemistry measures were conducted by enzymatic method. HDLs were purified and HDL proteome was analysed by the Orbitrap Fusion high-resolution mass spectrophotometer fronted with a NanoESi ion source and HDL quality was assessed by enzymatic methods.

Results: Participants with metabolic syndrome had significantly higher BMI, waist circumference, percent body fat, and abdominal fat relative to normal-weight participants. Biochemical measures showed higher triglycerides, fasting glucose and total cholesterol levels in metabolic syndrome patients. The HDL proteomic profile and functionality were significantly different between the two groups. The proteomic profile of the four postprandial curves anticipates that HDL proteome and functionality content could be modulated by postprandial hyperlipidemia.

Conclusions: Metabolic syndrome remodels the HDL proteomic and quality profile. Whereas, postprandial hyperlipidemia-associated HDL proteomic profile could help to understand the functional role of HDLs influenced by diet. In addition, our study could help to establish nutritional interventions to adjust the HDL proteomic profile based on a designed lipid intake, in order to assess HDL functionality improvements.

Keywords: Dietary fatty acids, High-density lipoproteins, HDL proteome, HDL quality, Metabolic syndrome

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-66
The Association between Dietary Diversity and Ischemic Stroke Incidence and Mortality by a Global Comparative study

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Background and objectives: According to the World Health Organization,15 million people worldwide suffer a stroke annually. Of these, 5 million die and another 5 million are left permanently disabled, placing a burden on family and community. Dietary and other lifestyle factors are the contributors to stroke, and there is a need to promote dietary habits that prevent stroke. In this study, we focused on dietary diversity and conducted a cross-sectional and longitudinal analysis using international data to determine whether a highly diverse diet inhibits ischemic stroke.

Methods: Data of ischemic stroke incidence and mortality by country were derived from the Global Burden of Disease (GBD) database. Average food supply (g/day/capita) and energy supply (kcal/day/capita) by country, excluding loss between production and household, were obtained from the Food and Agriculture Organization of the United Nations Statistics Division database (FAOSTAT). Each food was sorted across 14 food groups, and dietary diversity was obtained from food groups using the Quantitative Index for Dietary Diversity (QUANTIDD). As covariates, we used GDP per capita, aging rate, years of education, smoking rate, physical activity, obesity rate, energy supply, sodium intake, average systolic blood pressure, and average LDL cholesterol concentration obtained from the World Bank database and other sources. A cross-sectional association between QUANTIDD and incidence and mortality in 2009 was examined in 140 countries with populations of 1 million or more for which all data were available. A longitudinal association of QUANTIDD in 2009 with stroke incidence and mortality from 2009 to 2019, controlling for covariates at baseline using linear mixed models was also examined.

Results: In the cross-sectional model, QUANTIDD was significantly negatively associated with stroke incidence (β ± SE; -136.7 ± 57.8, p = 0.02) and mortality (-132.4 ± 49.8, p = 0.006). In the longitudinal model between QUANTIDD and year, the main effects of QUANTIDD on incidence and mortality were -140.7 ± 53.2 (p = 0.009), and -109.0 ± 37.7 (p = 0.005), respectively.

Conclusions: Dietary diversity was associated with decreased ischemic stroke incidence and mortality by cross-sectional and longitudinal analysis using international data.

Keywords: Dietary Diversity, Ischemic Stroke Incidence, Ischemic Stroke Mortality, Cross-sectional analysis, Longitudinal analysis

PAB(T4)-67
The associations between coronary artery disease (CAD) and the intakes of foods recommended as The Japan Diet in patients undergoing coronary angiography

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Background and objectives: Several cohort studies reported some associations between food intakes and CAD in a Japanese population. The Japan Diet (JD) was recommended to prevent atherosclerosis by Japan Atherosclerosis Society. However, studies investigating the associations between such food intakes and CAD or acute coronary syndrome (ACS) in patients undergoing coronary angiography are scarce.

Methods: We investigated the intakes of 5 foods (fish, soybeans, green/yellow vegetables, fruits, and seaweed) recommended as JD and the green tea and alcohol intakes in 802 patients undergoing coronary angiography. Foods intakes were divided into 3 categories (<3, 3–4 and >4 times/week) and were scored 0 to 2 points. JD score was defined as the sum of scores of 5 foods intakes. Green tea intake was divided into <1, 1-3 and >3 cups/day, and alcohol intake was divided into <1, 1-6 and >6 times/week.

Results: CAD was found in 511 patients, of whom 185 had ACS. Intakes of fish, vegetables and fruits were significantly lower in patients with CAD, especially with ACS, than in those without CAD. Soybeans and seaweed intakes tended to be lower in patients with CAD than without CAD. Green tea and alcohol intakes were significantly lower in patients with CAD, especially with ACS, than in those without CAD. JD score was lower in patients with CAD (4.0±2.2) than without CAD (4.6±2.0) and lowest in ACS (3.8±2.1)(p<0.001). JD score >5 was less frequent in patients with CAD (40%) than in those without CAD (56%)(p<0.001). In multivariate analysis, JD score and green tea and alcohol intakes were independent factors for CAD. Odd ratios for CAD were 0.50 (95%CI=0.36-0.71) for JD score >5, 0.61 (95%CI=0.41-0.90) for green tea >3 cups/day, and 0.53 (95%CI=0.36-0.78) for alcohol >6 times/week. Green tea intake was also an independent factor for ACS, but JD score and alcohol intake were not. Odd ratio for ACS was 0.63 (95%CI=0.40-0.98) for green tea >3 cups/day.

Conclusions: Foods recommended as The Japan Diet and green tea intakes were inversely associated with CAD, suggesting protective roles against the development of CAD in Japanese patients. Moreover, green tea intake was also associated with ACS.

Keywords: coronary artery disease, acute coronary syndrome, food intakes, green tea

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-68
Impact of sodium chloride on allergic symptoms and gastrointestinal barrier function in ovalbumin-induced food allergy in mice

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Background and objectives: To our knowledge, there have been no reports on the relationship between salt intake and food allergies. In this study, we investigated the effect of NaCl on allergy symptoms using a mouse model of food allergy.

Methods: Five-week-old female BALB/c mice were divided into four groups: Control (C) (n = 5); OVA (n = 8); OVA-NaCl 5% (NaCl 5%) (n = 7); and OVA-NaCl 10% (NaCl 10%) (n = 7) groups. The OVA, NaCl 5%, and NaCl 10% groups were sensitized on days 7 and 21 by intraperitoneal administration of aluminum adjuvant containing egg white albumin (OVA) to lightly anesthetized mice. The non-sensitized (C) group was sensitized with aluminum adjuvant without OVA. On the 36th day of the experiment, 20 mg of OVA was dissolved in PBS for the C and OVA groups, and in PBS containing 5% and 10% NaCl for the NaCl 5% and NaCl 10% groups, respectively, and orally administered to the mice. The following items were evaluated: (1) anaphylactic symptoms; (2) OVA-specific IgE in serum; (3) digestion and absorption of OVA; and (4) expression of tight junction-associated proteins in the jejunum. Results: Rectal temperatures were significantly decreased in all sensitization groups compared with group C (p> 0.05). Serum OVA-specific IgE was significantly higher in all groups compared with group C (p> 0.001). The portal blood OVA concentration in the NaCl 10% group was significantly higher than in the other groups (p> 0.05). In the histological observation of the small intestine, inflammation number of sites were significantly greater in the 5% and 10% NaCl groups compared with the C and OVA groups (p> 0.05).

Conclusion: A single administration of a high concentration of NaCl in a mouse model of food allergy increased allergen absorption because of inflammation of the small intestine and exacerbated allergic symptoms. The digestion of OVA and the barrier function of the gastrointestinal tract as an indicator of tight junction-related protein expression will be evaluated and the results will be reported in this presentation.

Keywords: type-1 allergy, salt, gastrointestinal barrier function, digestion and absorption, mice

PAB(T4)-69
Food voucher program improves the recovery rate of children aged 6-59 months suffering from moderate acute malnutrition (MAM) in the Far North Region of Cameroon

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Background: Research on moderate acute malnutrition (MAM) is limited, despite its high prevalence. This study assessed recovery and associated factors among children treated through a food voucher program (FVP) enabling access to local foods in Cameroon's Far North. All children 6-59 months were screened by community health workers using middle-upper arm circumference (MUAC). Children identified with MAM were referred to health facilities for confirmed diagnosis and enrollment in the FVP.

Methods: This longitudinal cohort study ran from March to August 2020 in Kaele health district. Study subjects were randomly selected among enrolled children using stratified sampling with the probability proportional to the size of each health area. At enrollment and bi-weekly follow-up examinations, health agents provided caretakers a voucher to redeem for a pre-defined food basket (milk, eggs, fruits, vegetables, red millet flour, sugar and oil) from pre-selected local vendors. Children remained in treatment until a MUAC measure of greater than 125 mm or the end of the 12-week program. Time-to-recovery was evaluated with multivariate Cox proportional regression hazard models with associations quantified using adjusted hazard ratio (aHR). The trend for MUAC, including its determinants, was studied with multivariate linear mixed effect models.

Results: Among 474 children aged 6-53 months in the study, MUAC increased significantly over visits (P<0.001). Overall, 78.3% recovered, half (50.9%) after the first food voucher. Recovery among children aged 24-53 months was 31% faster than those aged 6-11 months (aHR=1.31, p=0.05). Boys were 33% more likely to recover than girls (aHR=1.33, p<0.001). A one unit increase in weight-for-height Z-score (WHZ) was associated with 89% faster recovery (aHR=1.89, p<0.001). In multivariate models, children aged 12-23 months and 24-53 months showed 1.03 mm (β=1.03, p=0.002) and 2.44 mm (β=2.44, p<0.001) greater increase in MUAC during treatment than those aged 6-11 months. A one unit increase in WHZ was associated with 3.42 mm increase in MUAC (p<0.001). Mean MUAC in boys was 1.82 mm greater than girls (p<0.001)

Conclusion: Recovery in the FVP was comparable to Sphere standards, suggesting promise as an effective treatment for MAM. Child's WHZ, gender and age were associated with MUAC and time to recovery.

Keywords: Food voucher, MAM, Acute Malnutrition, Recovery, Helen Keller

Conflict of Interest Disclosure: Ismael Teta, Jennifer Nielsen, Volkan Cakir, and Rolf Klemm are staff of Helen Keller International that received the grant from USAID/OFDA to conduct the research. However, they were not involved in the funding decision. The remaining authors have no conflicts of interest to declare.

PAB(T4)-70
The association of homocysteine and angiogenesis in patients with hepatocellular carcinoma before and after tumor resection

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Background and objectives: Hyper-angiogenesis plays an important role in the development of hepatocellular carcinoma (HCC). High plasma homocysteine has been shown to be associated with angiogenesis. However, the impacts of homocysteine change before and after tumor resection on angiogenesis have not been fully investigated. The purpose of this study was to investigate the changes and associations of homocysteine and angiogenesis markers before and after tumor resection in patients with HCC.

Methods: This was a cross-sectional study. Forty-two HCC patients who were going to receive tumor resection were recruited from Taichung Veterans General Hospital, Taiwan. Demographic data, clinical characteristics, medication uses, medical histories and fasting blood samples were recorded or collected before tumor resection and one month after tumor resection. HCC tumor and adjacent normal liver tissue were collected during tumor resection surgery. Plasma and tissue levels of homocysteine, vascular endothelial growth factor (VEGF) and nitric oxide were measured.

Results: Patients had significantly increased plasma homocysteine and nitric oxide levels after tumor resection compared to levels before tumor resection, while there was no significant change in plasma VEGF levels before and after tumor resection. VEGF levels in HCC tissue were significantly higher than those levels in the adjacent normal tissue. Plasma homocysteine was positively correlated with VEGF concentration at post-resection. Levels of homocysteine significantly correlated with VEGF in HCC tissue.

Conclusions: The results imply that homocysteine might have an important role in angiogenesis of HCC development.

Keywords: Homocysteine, vascular endothelial growth factor, nitric oxide, hepatocellular carcinoma, tumor resection

PAB(T4)-71
International Ecological Studies on Chronic Obstructive Pulmonary Disease (COPD) related risk factors - Association with Undernutrition

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Background and objectives: In patients with COPD, resting energy expenditure is increased due to increased respiratory muscle oxygen consumption. There is also increased energy consumption and decreased appetite due to systemic inflammation, and more than 40% of patients have weight loss and undernutrition. Conversely, lower BMI may be a risk factor for COPD. We examined whether countries with a lower BMI have a higher prevalence of COPD and mortality after controlling for socioeconomic factors and lifestyle habits including smoking.

Methods: Prevalence rates and mortality of COPD and mean BMI for countries worldwide in 1990, 2005, and 2018 were obtained from the Global Burden of Disease (GBD) database. As covariates, we used GDP per capita, aging rate, years of education, smoking rate, physical activity, average BMI, energy intake, and air pollution (PM2.5 concentration) for each year obtained from the World Bank database and other sources. We conducted a linear regression analysis of COPD prevalence and mortality with mean BMI controlling for covariates in 144 countries with populations of 1 million or more for which all data were available.

Results: In the model between COPD prevalence and BMI controlling for covariates, β ± standard error of BMI was -235.8 ± 46.7 ($p<0.001$) in 1990, -125.6 ± 41.9 ($p=0.003$) in 2005, -84.7 ± 41.1 ($p=0.02$) in 2019. In the model between COPD mortality and BMI, β ± standard error of BMI was -7.63 ± 2.27 ($p = 0.001$) in 1990, -3.75 ± 1.57 ($p=0.02$) in 2005, -1.54 ± 1.31 ($p = 0.24$) in 2019. Smoking was significantly associated with COPD prevalence and mortality in all years.

Conclusions: BMI was significantly associated with COPD prevalence and mortality except mortality in 2019. The results that COPD prevalence and mortality were higher in countries with lower BMI suggests that underweight and undernutrition may have been risk factors for COPD. However, the effect of BMI on COPD prevalence and mortality has become smaller over time, suggesting that the influence of risk factors other than undernutrition may have increased.

Keywords: Chronic Obstructive Pulmonary Disease (COPD), Undernutrition, International Ecological Studies

PAB(T4)-72
Isoflavones inhibit hydrogen peroxide-stimulated secretion of angiotensinogen in mesangial cells

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Background and objectives: We previously reported that urinary angiotensinogen levels are increased during the development and progression of diabetic nephropathy. However, the regulation of angiotensinogen secretion in the kidneys is not clear. In this study, we investigated whether reactive oxygen species enhance the secretion of angiotensinogen by mesangial cells, and whether the antioxidative effect of isoflavones affects angiotensinogen secretion.

Methods: Mesangial cells were cultured in mesangial cell medium containing 2% fetal bovine serum (FBS), 1% mesangial cell growth supplement, and 1% penicillin/streptomycin. Cells were cultured in serum-free medium for 12 hours and then stimulated with hydrogen peroxide. Isoflavones (daidzein and its metabolite, equol) were also stimulated before the stimulation of hydrogen peroxide. Angiotensinogen levels in the culture media were measured using ELISA. The antioxidative effect (free radical scavenging activity) of the isoflavones was assessed using the DPPH method. 0.3 mM of DPPH solution was prepared in methanol and 0.5 mL of the solution was added to 0.5 ml of the diluted extract. The mixture incubated for 45 minutes in the dark, at room temperature, followed by absorbance reading at 515 nm. A lower absorbance indicated higher DPPH scavenging.

Results: Stimulation with hydrogen peroxide enhanced angiotensinogen secretion by 2.32-fold (0.157 ng/mL and 0.364 ng/mL in the control versus hydrogen peroxide group). Daidzein and equol suppressed hydrogen peroxide-mediated increase in angiotensinogen secretion by 59.3% and 62.3%, respectively. Analysis of the antioxidative activity of daidzein and equol using the DPPH assay showed that they decreased DPPH by 55.0% and 61.2%, respectively.

Conclusions: Our findings indicate that reactive oxygen species triggered angiotensinogen secretion by mesangial cells, which was suppressed by the antioxidative activity of the isoflavones.

Keywords: Isoflavones, angiotensinogen, antioxidative activity, kidney

Further Collaborators: Rana Auchi, Kotomi Ishizawa, Aoi Ichikawa, Ayaka Sano, Akari Sayama, Megumi Shibata, Nanoha Tsukimura, Suzuka Hasebe, Momoko Mito

PAB(T4)-73
Niacin supplementation attenuates capillary regression and oxidative phosphorylation enzyme depletion on unloading induced-skeletal muscle atrophy in rats

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Background and objectives: Inactivity causes muscle atrophy and capillary regression in skeletal muscle. Niacin induces hypermetabolism and may prevent capillary regression.

Methods: Adult female Sprague-Dawley rats were divided randomly into control, hindlimb unloading (HU), niacin (NA) and hindlimb unloading plus niacin supplementation (HU+NA) groups. Hindlimb unloading was carried out for 2 weeks in the rats belonging to the HU and the HU+NA groups. The rats of the NA and HU +NA group were administered niacin (750 mg/kg) using a feeding needle twice a day for 2 weeks.

Results: Hindlimb unloading resulted in capillary regression, decreased succinate dehydrogenase activity of the muscle fiber and slow fiber composition in the soleus muscle.

Conclusions: Niacin prevented capillary regression and mitochondrial dysfunction caused by the unloading of the soleus muscle. Thus, Niacin supplementation could be an effective therapy for maintaining the capillary network and mitochondrial metabolism of the muscle fiber under unloading condition.

Keywords: niacin, muscle atrophy, capillary regression, metabolism

PAB(T4)-74
Association of fish oil supplementation with incident dementia among diabetic patients

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Background and objectives: Dementia is becoming a serious health problem with aging of the population worldwide. Typically, diabetic patients have a higher risk of developing dementia than healthy individuals and thus efficient preventative strategies are needed. Although supplementation of n-3 polyunsaturated fatty acids (PUFAs) has been favorably linked with the risk of dementia in the general population, data on the effect of n-3 PUFAs among diabetic patients is lacking. We aimed to evaluate the prospective association between fish oil

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

supplementation and all-cause dementia risk among older diabetic patients.

Methods: 16,061 diabetic patients aged over 60 years from the UK Biobank were followed up during a mean duration of 7.7 years. The use of fish oil supplements, demographic and dietary information were collected by the touch screen questionnaire. Dementia was diagnosed using the International Classification of Diseases (ICD-9 and ICD-10). The hazard ratios (HRs) and 95% confidence intervals (95% CIs) were estimated using Cox proportional hazards models to evaluate the association between fish oil supplementation and dementia risk.

Results: 337 cases of dementia were confirmed after 123,486 person-years of follow-up. Fish oil use was inversely associated with risk of developing dementia among diabetic patients (P = 0.031), after adjustment for potential confounding factors. The HR (95% CI) of dementia for fish oil users was 0.76 (0.60-0.98) compared with non-users. Such inverse association was not modified by the APOE ε4 genotype. Higher consumption of oily fish and non-oily fish (more than 1 serving/week) had no significant association with dementia risk (P-trend=0.271; P-trend=0.065) compared with nonconsumers.

Conclusions: In older diabetic patients, fish oil supplementation was associated with a lower risk of developing dementia while oily fish and non-oily fish consumption had no protective association. Our findings provide new population-based evidence to support the use of fish oils for the primary prevention of dementia among diabetic patients.

Keywords: Fish oil, N-3 PUFAs, Dementia, Diabetic patients, older people

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: None.

PAB(T4)-75
Effect of dietary canna starch intake on a mouse model of food allergy

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Background and objectives: Previously, we have shown that feeding canna rhizome starch to mice may increase the intestinal barrier function and improve the intestinal environment. Here, we investigated the effects of canna starch intake in a murine food allergy model.

Methods: Five-week-old female BALB/c mice were divided into four groups: the CA and SA groups were fed ad libitum with AIN-93G; and the CC and SC groups were fed AIN-93G with 10% replaced with canna starch. In the sensitized groups, SA and SC, $Al(OH)_3$ containing egg white albumin (OVA) was administered intraperitoneally to lightly anesthetized mice on days 7 and 21. The mice in the non-sensitized groups, CA and CC, were administered $Al(OH)_3$ without OVA. Feces were collected on days 25–28. On day 28, 20 mg of OVA was orally administered to the mice. The following items were evaluated: (1) anaphylactic symptoms using rectal temperature as an index; (2) ability to produce various antibodies; (3) intestinal environment; (4) intestinal barrier function; (5) OVA uptake; and (6) tight junction (TJ)-related protein expression in the jejunum.

Results: Rectal temperature was significantly lower in the SA group, compared with the non-sensitized group, but no decrease was observed in the SC group. OVA-specific IgE was significantly higher in the SA group, compared with the nonsensitized, group, but was not increased in the SC group. The pH of the cecal contents showed a decreasing trend in the SC group, compared with the SA group. Fecal weight and fecal mucin content were significantly increased in the CC and SC groups, compared with the CA and SA groups. OVA uptake into the liver was increased in the SA group, and was decreased in the SC group to the same level as in the non-sensitized group. The level of claudin-1,7, a TJ-related protein, was decreased in the SA group and increased in the SC group.

Conclusions: Canna starch supplementation in a murine food allergy model leads to suppression of anaphylactic symptoms through suppression of OVA-specific IgE production, improvement of the intestinal environment, and a reduction in allergen uptake by increasing the intestinal barrier function.

Keywords: Canna starch, type-1 allergy, intestinal environment, IgE production, mice

PAB(T4)-76
Nutrient intake timing and exercise timing is associated with blood pressure.

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Background and objectives: cardiovascular diseases (CVDs) are one of the leading causes of death worldwide, and one of the most significant risk factors for CVDs is high blood pressure (BP). BP is associated with the intake of various nutrients, such as sodium, potassium, and cholesterol. However, research focusing on intake timing of these nutrients and BP has not been conducted. Furthermore, while physical activity has been suggested to take part in BP reduction, their timing effects also remain unclear. Therefore, we conducted two studies with the aim of hypertension prevention; (1) when each nutrient should be taken and (2) when exercise should be done.

Methods: (1) We used dietary data and a questionnaire asking about sleep, physical activity, and BP, collected from the food-log app "Asken" (N=2402), to investigate the relationship between the dietary data of nutrient intake in the breakfast, lunch, and dinner and BP.(2) We used questionnaire asking about the participants' systolic and diastolic blood pressure and weekly physical activity situation (length, frequency, intensity, and timing) to conduct analysis on their relationship (N=2343).

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Results: (1) Daily total intake of various nutrients such as sodium, sodium-to-potassium ratio, potassium, total energy, lipid, carbohydrate, and saturated fat showed a significant association with BP depending on the meal timing. From multiple regression analysis, eliminating the confounding factors, lunch sodium-to-potassium ratio, dinner energy, lipid, cholesterol, saturated fat, and alcohol intake were positively associated with systolic BP, whereas breakfast protein and lunch fiber intake showed a negative association. (2) Total physical activity, walking time and frequency, vigorous evening exercise (18:00-21:00) showed strong negative association with both systolic and diastolic BP. When participants were divided into groups according to the BP categories, compared to normal BP groups, higher BP groups exercised less in the evening.

Conclusions: Our results suggest that nutrient intake and exercise timing are important factors in the prevention of high BP. Our study provides possibilities to prevent hypertension by changing the timing of nutrient intake, especially sodium, together with potassium and lipids and by exercising in the evening. However, further research on the general population needs to be conducted.

Keywords: Blood pressure, Dietary pattern, Exercise, Chrono-nutrition, Sodium

Conflict of Interest Disclosure: MM is a corporate officer in Asken Inc. AT and NA are employees of Asken Inc. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

PAB(T4)-77
Development of a murine food allergy model with oral sensitization using a combination of antigens and NaCl

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Background and objectives: Elevated concentrations of Na^+ in the intestinal tract are predicted to cause injury to mucosal epithelial cells in the small intestine, leading to a reduction or loss of the barrier function, which increases the absorption of undigested allergenic proteins. The purpose of this study was to investigate the effect of NaCl on the absorption of allergenic proteins and the induction of oral sensitization by the continuous intake of NaCl and allergens.

Methods: Five-week-old female BALB/c mice were divided into two groups (n = 8): water and NaCl groups. The mice were fed CRF-1 diet and tap water or 1.0% NaCl solution ad libitum for 36 days. On the 36th day of the experiment, 10 mg of chicken egg white albumin (OVA) was administered into the stomach of sensitized mice, and the OVA concentration in portal blood was measured by sandwich ELISA. Next, to evaluate the effect of NaCl on oral sensitization, mice were divided into five groups (n = 8): Control; OVA; OVA–NaCl (ON); wheat gliadin (GD); and wheat gliadin–NaCl (GN) groups. For the rearing period during the experiment, the Control group was fed an AIN-93G diet, the OVA and ON groups were fed an AIN-93G diet containing 0.1% OVA, or 0.1% OVA and 1.0% NaCl, respectively, and the GD and GN groups were fed an AIN-93G diet containing 0.1% GD, or 0.1% GD and 1.0% NaCl, respectively, for 8 weeks. Serum OVA-specific IgE, IgG1, IgG2a, and IL-4 were evaluated every week using ELISA.

Results: The OVA concentration in portal blood after ingestion of 1.0% NaCl solution for 36 days was significantly higher in the NaCl group compared with the water group ($p < 0.001$). The levels of OVA-specific IgE, IgG1, IgG2a, and IL-4 in the serum will be determined to evaluate the effect of NaCl on oral sensitization and the results will be reported in this presentation.

Keywords: Food-dependent exercise-induced anaphylaxis, salt, oral sensitization, mouse model

PAB(T4)-78
High LDL-Cho-specific circulating miRNAs are predicted to be involved in metabolomic alterations and the development of a wide range of related diseases - target gene prediction and GO analysis.

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Background and objectives: The 2019 National Health and Nutrition Survey reported that more than 30% of men in their 40s have a high LDL cholesterol (LDL-Cho) level (F formula). Micro (mi) RNAs are small RNAs that collectively suppress the expression of various genes. Among the miRNAs are blood-secreted miRNAs (circulating miRNAs) that are secreted from secreting cells and act on target cells through the blood. In this study, we performed comprehensive identification of high LDL-Cho-specific circulating miRNAs, target gene prediction and Gene Ontology (GO) analysis, and aimed to predict the effect on metabolism and causality with related diseases.

Methods: Serum miRNA expression in healthy subjects and subjects with high LDL-Cho (serum LDL-Cho > 140 mg/dL) who had IC in men in their 40s and 50s was comprehensively analyzed by microarray, target gene prediction was performed using Targetscan and miRDB, and GO analysis was performed in conjunction with the Human Metabolome Database and Disease Jensen Database by Shiny GO application.

Results: We identified 30 circulating miRNAs with variable expression levels specific to high LDL-Cho, of which 4 miRNAs with increased expression were predicted to be involved in the alterations of metabolites such as phosphatidic acid (PA) (16:0 /

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

16:0) (Enrichment FDR = 0.0128; the same hereinafter), phosphatidylinositol (PI) (16:0 / 18:0) (0.0128), LysoPA (18:2 (9*Z*, 12*Z*) / 0:0) (0.0207), cytidine monophosphate (0.0261), and pyruvic acid (0.0354). Surprisingly, these four miRNAs were also predicted to be involved in the development of diseases associated with high LDL-Cho, including carcinoma (Enrichment FDR = 1.51E-177; the same hereinafter), acquired metabolic disease (8.51E-06), cardiovascular system disease (0.000864) and Alzheimer's disease (0.0103).

Conclusions: The results of this study suggested that the identified high LDL-Cho-specific circulating miRNAs are associated with metabolic alterations and the development of related diseases. In the future, we would like to describe the blood expression levels of the above miRNAs for each risk group with different numbers of important risk factors such as aging (men > 45 years), hypertension, diabetes mellitus, smoking, family history of coronary artery disease and low HDL cholesterol (< 40 mg/dL) for high LDL-Cho, and apply them to diagnostic markers.

Keywords: High LDL-Cho-specific circulating miRNAs, microarray, target gene prediction and GO analysis, Human Metabolome Database, Disease Jensen Database

Further Collaborators: Moeka Kawai, Asuka Shirai, Rion Abe, Mizuki Anzai, Mao Kamada, Haruka Kamito, Tsugumi Sakuma, Michiru Machida, Aoi Miyata, Natsuki Watanabe, Natsumi Oginome, Saori Morohashi, Terumi Hasegawa, Kimiko Takahashi and Yaeko Nakatani

PAB(T4)-79
Relevance of fat mass to lean body mass ratio to cancer all-cause mortality among middled-aged and elderly adults: a multicenter observational study

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Background and objectives: We aimed to investigate the association of fat mass (FM) to lean body mass ratio (RFL), percentage of body fat (PBF), FM with all-cause mortality among middle-aged and elderly patients.

Methods: This prospective population-based cohort study comprised 3206 patients with stage 0 to IV cancer aged >40 years. Fat mass, and percentage of body fat were measured by bioelectrical impedance analysis (BIA). Cox proportional hazard models were used and adjusted hazard ratios (HRs) were estimated.

Results: We revealed an inverted U-shaped association between RFL and all-cause mortality among men aged >60 years after adjusted for confounding factors. Compared with those in the lowest tertile of RFL, elderly men in the medium and highest tertile had a 38% and 33% lower hazard of death from any cause, respectively. After additionally adjusted for C-reaction protein, HR of medium tertile still remained significant, while HR of highest tertile was none. No significant association was observed among female or male aged less than 60 years. Similar trends were also found between PBF and FM and cancer mortality.

Conclusions: Our data indicated that supporting the improvement of fat reserve in tumor patients is of importance for long-term disease outcomes, especially for elderly men with inflammatory reaction.

Keywords: Fat mass to lean body mass ratio, percentage of body fat, fat mass, lean body mass, cancer mortality

PAB(T4)-80
A Functional Food Formulation for Diabetic Nephropathy

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Background and objectives: Diabetes is now a growing epidemic and became a life-threatening disease with subsequent chronic complications that arise. The distinctive pathways (polyol pathway, non-enzymatic glycation, and oxidative stress) are responsible for the disrupted molecular changes which leads to diabetic complications including diabetic nephropathy (DN). The current drugs maintain primarily blood glucose and hence, there is a need for adjunct therapies to address diabetic complications such as DN. Amla, Cinnamon, Ginger, Fenugreek, Pepper, Turmeric are proven to have a beneficiary role when individually tested against diabetes and its complications in our previous studies affecting the above-pathways. In the present study, we formulated a mixture of these functional foods in a specific proportion to study their synergistic effect against DN.

Methodology: Amla (0.2%), Cinnamon (0.2%), Turmeric (0.05%), Pepper (0.1%) Fenugreek (0.5%), Ginger (0.3%) has been fed in rat chow diet to STZ-induced SD rats of 8-week age. The formulation has been given in preventive/therapeutic approach. Proteinuria, AGEs-accumulation in glomerular region, podocyte structural protein disruption and inflammation were studied by biochemical, immunoblotting, qPCR, and immuno-fluorescence methods.

Result: The above functional food (FF) formulation has significantly prevented albumin and creatinine excretion (ACR) compared with diabetes. The mRNA levels of podocin were improved by 50% and nephrin by 80%. Immunofluorescence revealed FF ameliorated accumulation of CML and MGO in the glomerular region and receptor for AGE (RAGE). Expression of inflammatory markers (Tnf-Alpha, p-NfKb) was decreased in FF treated group. Increased autophagy (Beclin, ATG5, P62) protein expression of diabetes rats was corrected with the functional food.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusion: We have developed a FF formulation that has beneficiary effect in improving DN and can be used as an adjuvant therapy in managing DN.

Keywords: Diabetic Nephropathy, Functional food Formulation, AGE, Inflammation, Autophagy

Conflict of Interest Disclosure: NA

Further Collaborators: NA

PAB(T4)-81
Deciphering the role of dietary fatty acids on HDL (high-density lipoprotein) lipidome

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Background and objectives: The serum level of high-density lipoprotein cholesterol (HDL-C) is inversely correlated with atherosclerosis and cardiovascular disease (CVD) risk. However, randomized controlled trials did not show evidence reducing CVD when HDL-C was raised pharmacologically. It is therefore necessary to study in detail the molecular composition of these heterogeneous particles. Previous research has established that HDL lipidome plays an active role on HDLs structure and bioactivity. The latest cutting-edge lipidomic technology may then be helpful in HDL-targeted therapeutics. Our study aims to determine whether our dietary consumption of a variety of lipids may modulate the HDL lipidome in healthy or pathological conditions, anticipating changes in lipoproteins biochemistry or biofunctionality.

Methods: Two strategies have been assessed prior to determine lipidomic profile, functionality and HDL particle size in humans. Blood samples were collected from 20 healthy and 20 overweight volunteers. Another 5 healthy subjects agreed to consume four different diets, including no fat or saturated/mono-unsaturated/poly-unsaturated fatty acids, and blood was also recovered. Anthropometric data such as BMI, waist circumference, percent body fat or abdominal fat were recorded in all cases. HDLs were purified using a commercial kit and lipidome analysis was assessed by mass spectrometry. Nuclear magnetic resonance was used to determine HDL particle size.

Results: Anthropometric data reveal higher values in overweight when comparing with normal weight subjects, but no such a difference was reported for the interventional diet volunteers. Overweight subjects show a lower presence of lipids in HDL, in terms of the relative intensity detected and the number of different molecular species in every lipid family analysed by mass spectrometry. However, in the interventional assay, lipidome values among the participants were more similar. Particle size determination of HDLs provide comparable values of the most abundant molecules in both studies.

Conclusions: Lipidome profile appears to be a promising tool to evaluate the lipid populations' enrichment in both healthy and pathological conditions, as well as, for nutritional assays. Our results also anticipate that interventional strategies help to understand biochemical and functional changes in HDLs-C molecules, known to influence atherosclerosis or cardiovascular risk.

Keywords: High-density lipoproteins, Lipidome, Diet, Fatty acids, Postprandial metabolism

PAB(T4)-82
Associations of vegetable intake and primary industry workers with vitality: the Toon Health Study

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Background and objectives: Previous studies showed that farmers, which is a major type of primary industry workers, had a higher vegetable intake than non-farmers. Therefore, we hypothesized that primary industry workers are healthier than other occupational workers due to higher intake of vegetable. The purpose of this study was to examine the associations of vegetable intake and primary industry workers with health-related quality of life (HRQOL) among Japanese population.

Methods: The subjects of this cross-sectional study were 632 men and 1205 women aged 30-84 years who participated in the Toon Health Study from 2014 to 2018. Vegetable intake was assessed by food frequency questionnaire, and HRQOL was assessed by Short Form-8 (SF-8). The subjects were classified into three groups: primary industry workers, unemployed and housewives (husbands), and other occupational workers. Analysis of covariance and multivariable regression analysis were used to analyze the associations of vegetable intake and primary industry workers with vitality.

Results: We found that age-adjusted mean of vitality, intakes of green and yellow vegetables, and other vegetables for primary industry workers was higher than other occupational workers in men and women, respectively ($p<0.01$). We also found that higher intakes of green and yellow vegetables and other vegetables were positively associated with vitality (green and yellow vegetables: $\beta=0.020$ in men and $\beta=0.017$ in women; other vegetables: $\beta=0.010$ in men and $\beta=0.011$ in women, $p<0.01$). Comparing the age-adjusted differences of vitality between primary industry workers and other occupational workers ($\beta=-1.90$ in men and $\beta=-2.55$ in women, $p<0.05$), we found that differences were attenuated after adjustment for green and yellow vegetables intake in men ($\beta=-1.51$, $p=0.07$). However, we didn't find such attenuation after adjustment for green and yellow vegetable intake in women and for other vegetables in respective sexes.

Conclusions: Vegetable intake may contribute to higher vitality among male primary industry workers. However, we need to further examine the contribution of green and yellow vegetables intake for the differences of vitality between primary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

industry workers and the other occupational workers using other statistical approaches.

Keywords: Primary industry workers, vitality, vegetable intake

PAB(T4)-83
Low-birthweight rat due to embryonic undernutrition-changes in body composition after fasting-refeeding condition

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Background and Objects: When exposed to undernutrition, the fetus acquires a thrifty phenotype and a small body size as a trade-off that changes its own metabolic and endocrine systems. The thrifty phenotypes are beneficial for survival under malnourished conditions, but the mismatch between the thrifty phenotypes and the eutrophic environment increases the risk of developing the non-communicable disease. However, low birthweight infants do not always exhibit obesity, and the details of the molecular mechanisms underlying the basis of the thrifty phenotype are not yet understood. Therefore, we generated embryonic malnutrition-induced low birthweight model rats and investigated changes in bodyweight and body composition under starvation. In addition, we tested the effects of nutritional interventions on changes in bodyweight and body composition.

Methods: Low birthweight (LBW) rats due to maternal low carbohydrate-calorie restricted diet-fed were produced according to a previous report (Sci Rep, 10, 1339, 2020). All experimental procedures were reviewed and approved by the Laboratory Animals Ethics Review Committee of Nippon Medical School (#2020-003). As a nutrition intervention, lactating rats were fed a methyl modulator (IJMS, 22, 9767, 2021) diet for the first week soon after birth. Male rats were measured body weight, body composition, and blood hormone levels after exposed to fasting and refeeding.

Results: The LBW significantly lost bodyweight than control rats when exposed to fasting. After refeeding, the bodyweight of controls recovered to the basal level, whereas LBW failed to recover their weight gain. LBW did not reduce body fat percentage after fasting. LBW decreased skeletal muscle weight (per bodyweight) than controls during 48h-fasting and failed to recover after refeeding. Intervention with MD during lactation increased weight recovery after 48h-refeeding. Blood corticosterone, a catabolic hormone, levels were significantly higher in LBW than in the control, and blood IGF-1, an anabolic hormone, levels were significantly lower in LBW than in the control.

Conclusions: It was shown that our fetal malnutrition-induced low birthweight model rats may have acquired a thrifty phenotype with "hard-to-burn body fat" and "easy-to-lose muscle". The intervention after birth with methyl modulators for the thrifty phenotype may normalize such a phenotype induced by embryonic malnutrition.

Keywords: Low birthweight, body fat, muscle, hormone, thrifty phenotype

Conflict of Interest Disclosure: Nothing

PAB(T4)-84
The oral administration of D-fructose and D-allulose recovers the villous morphology and function of the small intestine in a rat model of total parenteral nutrition

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2. Yamagata University (Japan)

Background and objectives: Small intestinal epithelial cells maintain intestinal homeostasis by recognizing luminal nutrient stimulations. The reaction becomes especially sensitive when small intestinal functions decline markedly. Although it is believed that monosaccharide stimulation is effective in recovering the small intestinal functions, the type of monosaccharide that is most efficient for small intestine function recovery is still unknown. Therefore, we focused on D-fructose and D-allulose, which is C-3 epimer of D-fructose, and analyzed whether these monosaccharides can help recover the weakened small intestinal function.

Methods: We conducted total parenteral nutrition (TPN) surgery on 8-week-old male Wistar rats. The TPN group was administered TPN liquid, equating a total calorie count of 250 kcal/kg body weight/day, through a catheter inserted into the jugular vein for 7 days. In another group, rats were treated with the TPN for 7 days and were subdivided into three groups. Each group was orally administered 3 g/kg/day D-glucose (Gluc group), D-fructose (Fruc group), and D-allulose (Allu group) for 2 days, respectively. The Sham animals (used as controls for the TPN-treated animals) were given a standard diet and water *ad libitum* until the completion of the study following surgery. Nine days after the start of experiments, jejunoileal samples were removed from all animals in the Sham, TPN, Gluc, Fruc, and Allu groups and used for morphological analysis, gene and protein expression analysis, and the measurement of disaccharidase activity.

Results: In the Fruc group, the expression of representative molecules associated with digestion and absorption of nutrients and villous morphology mainly recovered compared with the TPN group ($p < 0.05$). In the Allu group, the expression of intestinal barrier-related molecules primarily increased. Additionally, the expression of lipids absorption related molecules such as fatty acid binding proteins significantly increased compared with the TPN group ($p < 0.05$). Significant recovery was not observed in the Gluc group.

Conclusions: There is a possibility that D-fructose and D-allulose are useful for recovering the small intestinal functions,

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DOI: 10.1159/000530786

such as digestion and absorption of nutrients and the intestinal barrier.

Keywords: D-fructose, D-allulose, Total parenteral nutrition, Small intestinal functions, Nutrients digestion and absorption

Conflict of Interest Disclosure: This work was supported by the funding from Matsutani Chemical Industry Co., Ltd.

PAB(T4)-85
Combined hypertension and hypoerythropoietinemia in zinc deficient rats

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Background and objectives: It is quite common that patients with chronic kidney disease (CKD) have hypertension and hypoerythropoietinemia. Some patients with CKD have iron- and erythropoietin-refractory anemia as well. We previously reported that zinc-deficient rats had decreased plasma erythropoietin concentration, i.e., hypoerythropoietinemia. Some scientists reported that zinc (Zn) deficiency induces hypertension, although the mechanism is not established. We aimed to investigate the physiological roles of zinc in erythropoietin production in kidney and blood pressure control.

Methods: Thirty 3-week-old male Sprague-Dawley rats were assigned into 3 dietary groups (n=10 each) and fed on experimental diets for 4 weeks: control group (AIN-93G; Control), zinc-deficient group (4.5 mg Zn/kg; ZD) and pair-fed group (AIN-93G; PF). At day 24-25, systolic, diastolic, and mean blood pressures were measured by the tail-cuff method. At day 27-28, body water distribution was measured. Quantitative real time RT-PCR using TaqMan proves was performed for mRNAs of EPO in kidney. Statistical analysis was performed by PLSD.

Results: Renal cortex EPO concentration was lower in ZD than PF. No significant difference was observed in renal medulla EPO concentration. Erythropoietin mRNA levels in both renal cortex and medulla were significantly different between ZD and PF. Blood pressures of ZD were highest and those of PF were lowest among all treatment groups. Blood pressures of ZD were significantly higher than PF. Plasma angiotensin converting enzyme activity and relative heart weight of ZD were significantly higher than PF and AC. Plasma angiotensin II concentration and intracellular water/extracellular water ratio of ZD were marginally lower than PF.

Conclusions: These results suggest that zinc deficiency causes both hypertension and hypoerythropoietinemia via decreased renal erythropoietin expression and thus production, and that zinc deficiency hypertension is not evoked by an increase of renin-angiotensin system and hemoconcentration.

Keywords: Zinc deficiency, anemia, hypertension, erythropoietin, renin-angiotensin system

PAB(T4)-86
Elucidating the novel regulatory mechanisms of beige fat cells by single-cell analyses and their implication in lifestyle diseases

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Background and objectives: Beige fat cells are an inducible form of thermogenic fat cells that exist within the white adipose tissue in a scattered manner. They are induced in response to certain external cues, such as cold exposure and nutritional factors. Increased beige fat biogenesis is reported to have a positive impact on metabolic health. Thermogenic fat in adult humans displays a molecular signature resembling murine beige fat cells. Therefore, beige fat cells could be a potential novel therapeutic target for the treatment of lifestyle diseases, such as obesity and type 2 diabetes. However, the developmental origin of beige fat cells and pathways regulating this process remain unclear due to adipose tissue heterogeneity.

Methods: We isolated the stromal vascular fraction from mouse adipose tissue and employed single-cell RNA sequencing. Adipocyte progenitor cells (APCs) were isolated using fluorescence activated cell sorting (FACS). Cluster of differentiation 81 (CD81)-deficient mice were generated using the CRISPR interference (CRISPRi) system.

Results: Single-cell RNA sequencing identified a unique subset of APCs marked by cell surface proteins, including platelet-derived growth factor receptor α (PDGFRα), stem cell antigen 1 (Sca1), and CD81. Thereafter, we isolated CD81 $^{+}$and CD81^{-} cells using FACS and confirmed that CD81^{+} cells possess cell-intrinsic plasticity to give rise to beige fat cells. Transcriptome analysis revealed that this beige APC population has high proliferative capacity relative to CD81^{-} cells. We then established experimental methods to analyze APC proliferation *in vitro* and *in vivo*. We identified some regulatory factors including cold exposure promote APC proliferation. To test whether CD81 is required for beige fat biogenesis, CD81-deficient mice (CRISPRi-*Cd81* mice) were generated. Compared with control mice, the CD81-deficient mice exhibited impaired APC proliferation and *de novo* beige fat biogenesis following cold exposure. Moreover, the loss of CD81 led to diet-induced obesity, glucose intolerance, and insulin resistance.

Conclusions: These data suggest that CD81 marks beige APCs and controls APC proliferation along with beige fat biogenesis and whole-body energy metabolism. Our findings indicating that nutritional factors promote beige APC proliferation could be a novel approach to promote beige fat biogenesis and prevent lifestyle diseases.

Keywords: Single-cell RNA sequencing, beige adipocyte progenitor cells, cell proliferation, energy metabolism, lifestyle diseases

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-87
Plant-protein Rich, Low-calorie Diet to Improve Metabolic Health in Prediabetic Chinese Adults – A Randomized Controlled Trial

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Background: Legumes are naturally rich in plant protein, dietary fibre and various phytonutrients. While previous studies have indicated beneficial effects of legume rich diets on metabolic health, whether they provide additional benefits as part of a calorie restricted diet is not known.

Objective: To investigate the effects of a legume rich, lower calorie, low glycemic index (GI) diet, with added spices and healthy oil blends on metabolic outcomes, as compared with a lower calorie animal protein diet.

Methods: A 16-weeks, parallel-design, randomized controlled trial was undertaken in 127 Chinese prediabetics (aged 62.3 ± 6.4 years, BMI 24.2 ± 2.5). Participants were randomized to 2 groups: a low-GI, legume-rich plant protein with healthy blended oil treatment group (n = 63); or a high-GI, animal protein with refined corn oil control group (n = 64). Both groups were provided with calorie restricted meals, twice a day, while the remaining third main meal was chosen freely, with guidance from research dietitian to ensure total calorie compliance within range. Baseline and post-intervention glycemic and lipid profiles were assessed once every 4 weeks. Linear mixed effects model was used for analysis on the change from baseline values with treatment, time and the interaction as fixed effects variables.

Results: Compared with baseline, at the end of 16 weeks, there were significant reductions in body weight, LDL cholesterol, total cholesterol, HbA1c and HOMA-IR (all $p<0.05$). Those in treatment group had significantly greater reduction in LDL (mean difference: -0.14 mmol/L, $p = 0.02$) and total cholesterol (mean difference: -0.21 mmol/L, $p = 0.006$) from baseline overall as compared to control group, although there were no differences between the two groups on markers of glucose homeostasis.

Conclusions: Consumption of a low calorie, low GI, legume-rich diet with healthy blended oil can improve cardiometabolic risk factors in a prediabetic Chinese population. Calorie restriction *per se*, controlling for meal sizes, may be a greater predicator to improve glucose homeostasis, than dietary quality alone. Food based intervention forms an important strategy to reduce risk of type 2 diabetes and cardiovascular diseases in Asia.

Keywords: Food Based Intervention, Legumes, Plant Proteins, Prediabetes, Lipid Profile

Conflict of Interest Disclosure: The authors declare no conflict of interest. Kat Hui Wong Long is an employee of Wilmar International Ltd.

PAB(T4)-88
Multimorbidity and its behavioural risk factors in Japanese community-dwelling older people: A cross-sectional analysis in the Nagasaki Islands Study (NaIS)

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Background and objectives: Population ageing in Japan is leading to rapid and substantial increases in the prevalence of multimorbidity. More attention should be paid to its patterns and risk factors. The objectives of this study were to examine the prevalence and patterns of multimorbidity and investigate how the prevalence and patterns of multimorbidity are associated with behavioural risk factors (BRFs) among Japanese community-dwelling older people.

Methods: The study sample comprised residents aged over 60 who participated in the Nagasaki Islands Study (NaIS) between 2017 and 2019 in Goto city, Nagasaki prefecture, Japan. Multimorbidity (2 or more chronic diseases) was coded according to the chapters of the International Classification of Diseases (ICD-10) from a list of 24. Multimorbidity patterns were extracted conjointly using hierarchical cluster analysis (HCA) and exploratory factor analysis (EFA). Five BRFs were evaluated: 1) alcohol consumption, 2) smoking habit, 3) physical activity, 4) sleep duration, and 5) eating habit. Each BRF was given a score of 1 (unhealthy) if recommended behavioural targets were not achieved or 0 otherwise. The accumulative effect of unhealthy BRFs was evaluated using the total sum of scores. Logistic regression was used to examine the association of multimorbidity with BRFs. Analyses were stratified by gender, and models were adjusted by age.

Results: A total of 2,815 older participants (62.2% females; 84.2% had multimorbidity) were analysed. We identified 3 multimorbidity patterns (2 for females and 1 for males). Mean number ± standard deviation (SD) of unhealthy BRFs were 0.93 ± 0.79 for females and 1.68 ± 0.93 for males. For females, no association of multimorbidity with BRFs was found. For males, multimorbidity was associated positively with smoking habit [1.51 (1.05-2.19)] and with accumulative unhealthy BRFs [1.96 (1.03-3.71)].

Conclusions: This is the first study to quantify multimorbidity and to examine its associated BRFs for Japanese community-dwelling older people. These results highlight the emerging concern about multimorbidity and underpin the need to develop effective public health interventions to prevent and manage multimorbidity.

Keywords: Multimorbidity, Health behaviour, Risk factor, Japanese, Community medicine

PAB(T4)-89
User-profiles, barriers and facilitators in adherence to the dietary pattern in diabetes. Functionalities needed in SMARTCLOTH, a digital tablecloth for people with diabetes

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Background and objectives: Diabetes mellitus (DM) affects all countries and represents a challenge for their healthcare systems. Besides, the lack of adherence to the diet is one of its most significant weaknesses. For this reason, we are developing a device (hardware) called SMARTCLOTH. It consists of a digital cloth for helping people with diabetes follow the recommended diet and, consequently, ensure greater adherence. Therefore, the main objective of this initial research was to identify the different user profiles, the barriers and the most frequent facilitators in this type of patient and, based on them, to define the main functionalities that this hardware should present to facilitate the follow-up of the diet for these patients.

Methods: We followed an end-user-centred design through an agile methodology known as Design Thinking. Various qualitative techniques (focus groups and in-depth interviews) were used with patients and professional experts in diabetes education (n=15) to identify patient profiles and explore barriers and facilitators.

Results: Four types of potential users were identified: (i) adolescent insulin-dependent (DM1), (ii) adults with DM2, (iii) aged patients with DM2 and (iv) women with gestational diabetes. In addition, we identified as main barriers: difficulty in understanding the relationship between intake and glycemia, monotony in the diet, lack of time for health professionals to carry out health education, and lack of motivation or ineffective emotional management of patients. Access to weekly menus and recipes, immediate feedback on the nutritional value of the food eaten, and family or caregiver support have been highlighted as facilitators.

Conclusions: The variability of potential users of SMARTCLOTH requires that the handling of the device be very intuitive basic and ensure high usability without requiring a high degree of technological literacy. SMARTCLOTH must identify different types of foods groups, include a weighing system, and report the amounts of macronutrients, being exceptionally accurate on carbohydrates. The development of inexpensive and straightforward recipes could also increase its efficiency.

Keywords: Diabetes Mellitus, Diet Adherence, eHealth

Conflict of Interest Disclosure: None. This research is framed within the project "SMARTCLOTH.Design, implementation and study of the effectiveness of a digital tablecloth for diet self-management in diabetic patients" [PI21/01602] funded by the Instituto de Salud Carlos III in the call 2021 of the Strategic Action in Health 2017-2020 (Government of Spain).

PAB(T4)-90
Nickel deficiency hypertension is stronger than salt hypertension in female rats

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Background and objectives: Although vegetables and beans are well-known by their hypotensive effects, the responsible factors are not well identified. Vegetables and beans are rich in the ultratrace element nickel (Ni). Therefore, we tested a hypothesis that nickel may have a physiological role in blood pressure regulation using experimental rats.

Methods: Forty-eight four-week-old female Sprague-Dawley rats were divided into four groups and fed four different diets for nine weeks. Control diet, supplemental Ni 0.5 mg/kg and no additional sodium chloride (NaCl); Ni-deficient diet, no supplemental Ni and no additional NaCl; NaCl-excess diet, supplemental Ni and additional 4%(w/w) NaCl; Ni-deficient/NaCl-excess diet, no supplemental Ni and additional 4% NaCl. Blood pressures were measured by the tail-cuff method a day before the start of the regimen (baseline) and then biweekly later. Increments of blood pressures from baseline were statistically analyzed by Dunnett's test (two-tailed). P values less than 0.05 were considered significant.

Results: At two weeks on dietary regimen, systolic blood pressure of the rats fed Ni-deficient diet was significantly higher than that of the rats fed control diet. At four weeks, systolic blood pressure of the rats fed Ni-deficient diet was significantly higher than that of the rats fed control diet. At six weeks, systolic and mean blood pressures of the rats fed Ni-deficient diet and Ni-deficient/NaCl-excess diet were significantly higher, and diastolic blood pressure of the rats fed Ni-deficient diet was significantly higher compared to the rats fed control diet. At eight weeks, all systolic, mean and diastolic blood pressures were significantly higher in the rats fed Ni-deficient diet and Ni-deficient/NaCl excess diet, while only systolic and mean blood pressures were significantly higher in the rats fed NaCl-excess diet compared to the rats fed control diet.

Conclusions: These results suggest that Ni deficiency causes hypertension, and the hypertensive effect of Ni deficiency is stronger than NaCl excess of 4%(w/w).

Keywords: Hypertension, nickel deficiency, salt overload, blood pressure, mineral

PAB(T4)-91
A longitudinal analysis of insulin resistance in children, 2–8 years old, living in the Pacific Region, the Children's Healthy Living Program

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Introduction: The global prevalence of childhood obesity has significantly increased, putting children at a greater risk for type 2 diabetes mellitus (T2D). Acanthosis nigricans (AN), a dark, velvety discoloration of skin often occurring on the neck is a sign for insulin resistance. There are limited longitudinal studies on how changes in body mass index (BMI) and diet are associated with AN. This study determined how changes in BMI z-scores and diet over a 2-year period for children 2-8 years old living in the Pacific region were associated with AN.

Methods: Children (n=693) assessed at baseline and at follow-up for BMI, food intake, and the presence of AN were included in this analysis. Food intake records were collected from caregivers for two randomly assigned non-consecutive days at each time-period to assess nutrient, and food group intakes and adjusted for within child variation. Multiple regression and multinomial regression were used to determine factors associated with AN at follow-up and 2-year changes in AN status.

Results: The baseline prevalence of AN was 5%. All children who developed or maintained AN were overweight or became overweight. No children who went from overweight or obese to not being overweight had AN at follow-up. Controlling for age, sex, study group, baseline BMI, change in BMI z-score, and time between assessments, each teaspoon increase in added sugar or refined carbohydrate serving significantly increased the risk for the presence of AN at follow-up by 9% and 7%, respectively ($p < 0.01$); an increase in added sugar (OR: 1.16, $p<0.05$) or refined carbohydrate food servings (OR: 1.15, $p<0.01$) also increased the risk for developing AN. Increased servings of citrus (OR: 0.05, $p<0.01$) and fruit (OR: 0.29 ($p<0.05$) were protective for AN. No nutrients were associated with the presence of AN.

Conclusions: Added sugar and refined carbohydrate foods independently increased the occurrence of AN suggesting the source of carbohydrates is a factor for the development of AN. Obtaining a healthy weight and decreasing the intake of refined carbohydrates are critical to preventing AN in young children.

Keywords: Children, Type 2 Diabetes, Acanthosis Nigricans, Diet, Body Mass Index

Conflict of Interest Disclosure: Dr. Taren receives financial support from the International Life Sciences Institute for being the Editor-in-Chief for Nutrition Reviews. Dr. Novotny receives funds for being an associate editor for Nutrition Reviews.

PAB(T4)-92
An investigation into the impacts of early access to a dietitian-led multimodal cancer cachexia intervention in metastatic cancer (CACHEXIA-CARE): an RCT protocol

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Background and Objectives: The management of cancer-related malnutrition (CRM) and cachexia (CC), remains challenging due to its multifactorial aetiology. While multimodal interventions have been proposed to target the complex aetiology, further pragmatic trials are required to demonstrate efficacy. Moreover, while efficacy of interventions is reported to be poor in advanced CC, there is no validated means of identifying patients early in the CRM trajectory who might benefit from intervention.

Methods: This RCT will recruit 70 patients with incurable pancreatic, oesophageal, gastric or lung cancer due to begin first-line systemic treatment. To achieve 80% power for the primary outcome, n=30 is required, while n=70 allows for greater variation in secondary outcomes. Patients will be randomised 1:1 (open-label) to intervention or control arms. The personalised 12-week multimodal intervention (initial consultation with a registered dietitian (RD) + weekly follow-up) includes dietary counselling (ESPEN targets), symptom management, exercise prescription (population targets) and 2 daily servings of a novel powdered oral nutritional supplement for reconstitution (46 g + 150 ml whole milk provides 264 kcal, 26 g protein (incl. 3.5 g Amino L40© (leucine-rich amino acid blend)) & 7.5 mcg vitamin D_3). The control group receive no routine dietetic input. All patients receive standard oncological care and written resources on diet and cancer.

Results: Assessments at weeks 0, 2, 4, 8 and 12 will use a variety of simple and gold-standard techniques (including anthropometry, bioelectrical impedance & CT body composition analysis) to comprehensively monitor nutritional, functional and clinical status. The primary outcome is CC prevalence in intervention vs. control at week 12, according to the 2011 International Consensus Criteria. Analyses will be conducted on an intention-to-treat basis. Secondary & exploratory outcomes include intervention feasibility, relative efficacy according to CRM severity at recruitment, intervention impact on quality of life, physical activity level, overall survival and clinical complications as well as the diagnostic validity of various nutritional assessment methods.

Conclusions: This RCT will add to the emerging evidence-base for multimodal interventions in advanced cancer, and will examine the validity of currently available assessment techniques in appropriate selection of patients with potential to benefit from such interventions.

Keywords: Cancer, Malnutrition, Cachexia, RCT, Dietetics

Conflict of Interest Disclosure: ESS is an IRC Enterprise Partnership Scheme Fellow, whose research is funded by the

Irish Research Council and Nualtra Ltd. Nualtra Ltd. are providing the oral nutritional supplement for use in this trial at no cost, and the novel ingredient (Amino L40©) is an Ajinomoto product. Nualtra Ltd. is a wholly owned subsidiary of Ajinomoto.

Conflict of Interest Disclosure: Authors declare no conflict of interest.

PAB(T4)-93
Effect of an online nutritional intervention on anthropometric parameters of overweight and obese adults

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Background and objectives: Obesity and dyslipidemia are risk factors that predispose to the development of cardiovascular diseases. The pathogenesis of these diseases involves environmental and genetic factors, such as polymorphisms associated with alterations in lipid metabolism. Adequate and precise nutrition is essential for preventing, treating, and controlling these pathologies. However, considering the consequences of social distancing generated by the pandemic, online nutritional counselling is a potential tool for nutritional care that should be provided to the population. This study assessed the effect of online nutritional counselling on anthropometric parameters of overweight or obese adults using two dietary patterns.

Methods: Sixty overweight or obese Mexican adults were recruited and randomly assigned to follow for eight weeks, into two groups accordingly to two previously created nutrigenetic patterns: a) low fat-low glycemic index-high protein pattern, or b) low saturated fat-high unsaturated fat-low carbohydrate pattern. Monitoring of participants was carried out remotely through a virtual platform, and multimedia teaching material was created and provided for the orientation and adherence of participants to the treatments. Results were collected at baseline, in the middle, and at the end of the intervention.

Results: 52% (n= 32) of the recruited population were women (30.2± 8.2 YO). At the beginning of the intervention, 57% (n=34) of the participants were obese and 43% overweight (n=26). At the end of the intervention, significant weight loss and decreased BMI were observed in patients of both groups (35% obesity, 51% overweight, 14% normal weight), as well as a reduction in waist and hip circumference. The entire population reported improvement in their dietary habits due to online nutritional advice. Loss to treatment follow-up was 38%.

Conclusion: Online nutrition is a viable and feasible tool for nutritional care during confinement and posterity. Developing virtual strategies for adherence to the diet and the motivation to change habits is essential. Both eating patterns evaluated were beneficial to promote weight loss and the reduction of anthropometric measurements of the participants.

Keywords: Online nutrition, obesity, overweight, dietary pattern, dietary strategies

PAB(T4)-94
Effects of citrate synthase insufficiency on nutrient and energy metabolism in pressure overloaded heart

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Background and objectives: The heart is flexible in substrate selection, utilizing lipids as oxidative substrates under normal conditions and carbohydrates as oxidative substrates under loading conditions such as pressure overload. In recent years, it has been suggested that the decrease in mitochondrial function induced by chronic stresses, such as aging and pressure overload, may contribute to the decline of cardiac function. However, the effects of mitochondrial dysfunction on metabolic flexibility remain unclear. In this study, we investigated the metabolic changes in the hearts of mice with hetero knockout (KO) of citrate synthase (CS), an important mitochondrial enzyme.

Methods: Male CSKO mice aged 16 to 20 weeks and their wild-type (WT) siblings were injected with Angiotensin Ⅱ (Ang Ⅱ, 800 ng/kg BW/min) using a subcutaneously implanted osmotic pump. On the 8th day of treatment, the mice were dissected and the hearts were harvested to examine ATP content and the expression of genes related to the substrate utilization. In addition, immunostaining was performed for histological examination, and anabolic and catabolic signals were also examined.

Results: When the mice were loaded with Ang Ⅱ, myocardial ATP content tended to be decreased in CSKO mice compared to WT mice. The expression of genes involved in the uptake and utilization of various substrates, such as glucose, lipids, lactate, and amino acids were significantly upregulated in the CSKO group. The cardiac expression of genes related to mitochondrial respiratory chain complex was also elevated in CSKO mice. Histological examination showed a significant decrease in the cross-sectional area of myocardial fibers in the heart of CSKO mice. The protein analysis revealed a decrease in Akt signaling activity and induction of autophagy in CSKO heart, as assessed by the specific marker LC3.

Conclusions: In this study, it is suggested that the hearts with impaired mitochondrial function adapt to pressure overload by using variety of energy substrate, but are unable to generate sufficient ATP, leading to myocardial atrophy induced via autophagy.

Keywords: Heart, Angiotensin Ⅱ, Knockout mouse, Citrate synthase, Nutrient metabolism

PAB(T4)-95
A longitudinal attempt to accumulate higher peak bone mass in Japanese adolescents in order to prevent osteoporosis in later life

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Background and objectives: Bone mass is determined by the amount of bone accumulated at the completion of skeletal growth, known as peak bone mass (PBM), and by the amount of bone lost during the remainder of life. It is estimated that a 10% increase in PBM could reduce the risk of osteoporotic fracture by 50% in later life. This study attempted to elucidate whether PBM can be increased through education for adolescents on dietary habits and a physically active lifestyle.

Methods: The subjects were adolescent girls (10 to 12 years old) in the 5th to 6th grade of elementary school, and from the 1st to 3rd grade in high school (12 to 15 years old). Bone mass was measured at os calcis by quantitative ultrasound (GE: A1000 InSight) in spring every year from 2013 to 2017 and also in autumn of 2016 and 2017. Subjects were instructed in the importance of prevention of osteoporosis, and in the age-appropriate improvement in calcium and vitamin D intake together with physical activity. Questionnaires regarding food intake, physical activity and other lifestyle factors from childhood were carried out at the time of bone measurement. Informed consent was obtained from subjects, and the study was approved by the Ethical Committee of their educational institution.

Results: Based on cross-sectional observation, PBM was presumed to be reached at around 12 to 13 years, and subjects' bone mass was associated with menarche age, body mass index, calcium intake from childhood, and physical activity. However, after instruction regarding osteoporosis, longitudinal study shows that PBM developed continuously till the age of 15 years, and that PBM increased by over 10%. Subjects had increased their daily food intake (40%), vitamin D intake (10%), and physical activity (30%) after osteoporosis education. Most students had discussed bone mass and osteoporosis with their family and friends (80%).

Conclusion: Appropriate timing of education on osteoporosis prevention with measurement of bone mass in adolescents could increase PBM over 10%, thereby effectively decreasing the occurrence of osteoporosis in later life.

Keywords: Bone measurement, Calcium intake, Vitamin D, Physical activity, Education

Conflict of Interest Disclosure: This research was conducted with a research grant from the Japan Osteoporosis Foundation.

PAB(T4)-96
High LYRM4-AS1 predicts poor prognosis and correlates with immune efficacy in patients with glioma

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Background and objectives: Long non-coding RNAs are proved to be involved in the development of glioma. Our previous research screened the differentially expressed genes through The Cancer Genome Atlas (TCGA) database and identified the molecule LYRM4-AS1.As a lncRNA, the expression level and biological function of LYRM4-AS1 in glioma are unclear. Therefore, we attempted to assess the expression, clinical significance and related mechanisms of LYRM4-AS1 in glioma.

Methods: RNA-seq data with clinical information were obtained from TCGA datasets. The LYRM4-AS1 expression level was evaluated. Kaplan-Meier method was used to constructed survival curves. Independent variables were analysed by Cox regression analysis. The median LYRM4-AS1 expression value in glioma tissues was used as cut-off value to divide patients into high and low expression groups. The RNA-seq data were compared between high and low LYRM4-AS1 expression groups to identify differentially expressed genes (DEGs) using the DESeq2 R package. Then, gene set enrichment analysis (GSEA) was performed by clusterProfiler R package. Next, the single-sample Gene Set Enrichment Analysis (ssGSEA) was done by GSVA R package to quantify the immune infiltration of 24 types of immune cells in glioma tissues and the relative enrichment score of every immune cell was quantified from gene expression profile for each glioma tumor tissues. Spearman correlation analysis was used to analyze the correlation between LYRM4-AS1 and biomarkers of immune cells as well as immune checkpoints in glioma. All statistical analyses were performed using R (v.3.6.2).

Results: We found that LYRM4-AS1 was upregulated and related to the grade and malignancy of glioma. Survival analyses showed that patients with high LYRM4-AS1 expression had worse clinical outcomes. Cox regression analyses demonstrated that LYRM4-AS1 was an independent risk factor for OS in patients with glioma. Enrichment analysis and immune infiltration analysis showed interferon signaling and cytokine-cytokine receptor interaction enriched in the LYRM4-AS1 high-expression phenotype, and LYRM4-AS1 showed significantly positively correlated with immune infiltration and immune checkpoints.

Conclusions: These findings indicated that the increased LYRM4-AS1 might be a potential biomarker for the diagnosis and prognosis of glioma and might participate in the immune efficacy of patients with glioma.

Keywords: LYRM4-AS1, glioma, prognosis, immune efficacy, bioinformatics analysis

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-97
Difference of sterol metabolism between mice and rats in response to a high-fat diet or diet supplemented with cholic acid

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Background and objectives: Diagnosis of simple fatty liver, an early manifestation of metabolic dysfunction-associated fatty liver disease, is useful for prevention of hepatic diseases that includes hepatitis or cirrhosis. We found that the ratio of 12α-hydroxylated (12αOH) bile acids (BAs)/non-12αOH BAs in enterohepatic circulation of rats and mice positively correlates hepatic lipid accumulation. In addition, the changes in 12αOH BA were more prominent in rats than that in mice upon high-fat (HF) diet. Therefore, we tried to clarify difference of neutral and acid sterol metabolism between rats and mice under HF- or cholic acid (CA)-supplemented conditions.

Methods: C57BL/6JJmsSlc male mice and WKAH/HkmSlc male rats were fed a HF diet or a CA-supplemented diet at 0.5 g/kg diet for several weeks and analyzed sterol metabolism with regard to lipid metabolism including neutral sterols and BAs.

Results: In mice, the proportion of non-12αOH BAs was higher than that of 12αOH BAs. In contrast, the proportion of 12αOH BAs especially in enterohepatic circulation was higher than that of non-12αOH BAs in rats. In rats, HF-diet increased portal 12αOH BA concentration that correlated hepatic triglyceride concentration in HF-fed rats. On the other hand, such simple correlation was not observed in mice, and it is required to calculate the proportion of 12αOH/non-12αOH BAs to find a significant correlation with hepatic triglyceride concentration upon HF diet. Hepatic 7α-hydroxycholesterol was found to be increased in rats fed HF diet. On the other hand, major oxysterols were increased in the liver of HF-diet-fed mice. Also, mice excreted cholesterol directly into feces at a high amount under HF diet. Basically, feed efficiency was 10 times higher in rats than mice, indicating an enhanced energy expenditure in mice than in rats. The CA-supplementation developed hepatic steatosis in rats whereas there was no apparent such symptom was observed in mice.

Conclusions: This study clearly demonstrated the difference of cholesterol metabolism between mice and rats fed HF diet that reflected hepatic responses to CA supplementation. Significant roles of 12αOH BAs in hepatic triglyceride concentration became obvious both mice and rats under careful evaluation of metabolism especially in neutral and acid sterols.

Keywords: Bile acid, Cholesterol metabolism, 12α-hydroxylated bile acid, Lipid accumulation, Metabolic dysfunction-associated fatty liver disease

PAB(T4)-98
Association between nutritional status, physical function, and physical activity in patients with rheumatoid arthritis

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Background and objectives: The muscle loss in patients with rheumatoid arthritis (RA) is affected not only by abnormal immunity but also by pain-induced deterioration of physical activity and nutritional status. However, it is not clear to what extent nutrition and physical activity will affect the muscle loss. The purpose of this study is to clarify the association between nutritional status, physical function, and physical activity in patients with RA, and to obtain basic data for constructing reasonable lifestyle guidance for patients with RA.

Methods: Nine RA female patients (mean age 67.6 ± 8.6 years) with low Disease Activity Score in 28 joints were included. The duration of RA was asked. Body composition by biometric impedance scale were measured. Physical function was measured with the modified Health Assessment Questionnaire (m-HAQ) and grip strength. Physical activity was assessed daily steps using an activity monitor. Mini Nutritional Assessment (MNA) was used to assess nutritional status. Those with an MNA score of less than 23.5 points were classified as "suspected undernutrition". We compared it with the data released by the National Health and Nutrition Examination Survey.

Results: The average duration of illness in 9 patients was 22.2 ± 9.7 years. The average BMI was 22.2 ± 2.4 kg/m^2, and the body fat percentage was 31.6 ± 5.2%. Three patients taking 7 different medications were judged to be suspected undernourished. All but these three were judged to be in remission by m-HAQ. The grip strength was 12.8 ± 6.2 kg, and the number of steps per day was 5248 ± 1390 steps.

Conclusion: There was no difference in the daily step counts and BMI between the RA patients of this study and the National Survey. The grip strength was about 50% of the national average value except for 1 person. Therefore, it was clarified that the amount of physical activity in terms of the number of steps does not directly affect physical dysfunction. Undernutrition in RA patients represent a novel and under-researched topic and further studies are warranted to understand whether improved nutritional status would be associated with improved physical function and physical activity.

Keywords: Rheumatoid arthritis, Mini Nutritional Assessment, modified Health Assessment Questionnaire, Grip strength, Physical activity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-99
Green coffee bean extract protects muscle capillary regression via decreased oxidative stress under disuse condition

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Background and objectives: Inactivity causes muscle atrophy and capillary regression in skeletal muscle. Green coffee bean contains a significant amount of chlorogenic acid which has an antioxidant capacity and may prevent capillary regression. Therefore, the protective effects of chlorogenic acid on inactivity-induced capillary regression in rat soleus muscle were investigated.

Methods: Twenty male Wistar rats were randomly divided into four groups: control (CON), chlorogenic acid supplementation (CGA), 2-week hindlimb unloading (HU), 2-week hindlimb unloading plus chlorogenic acid supplementation (HU+CGA). The rats in CGA and HU+CGA groups were orally administrated chlorogenic acid (850 mg/kg/day). The soleus muscle was removed and made into sections for histochemical analyses.

Results: Unloading resulted in a decrease in capillary number, oxidative capacity, and an increase in oxidative stress of the soleus muscle, whereas chlorogenic acid supplementation prevented the capillary and metabolic changes resulting from unloading by reducing oxidative stress.

Conclusions: In conclusion, chlorogenic acid supplementation may qualify as an effective treatment to reduce capillary regression in skeletal muscle caused by the inactive condition.

Keywords: Inactivity, Oxidative stress, Chlorogenic acid

PAB(T4)-100
Fermented Composite Cereals Promote Healthy Gut in Sleep-Deprived Epileptic Rats

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Background and objectives: Probiotics in fermented cereals are capable of suppressing potentially pathogenic microorganisms in the gut, enhance immune system, improve resistance to infection and prevent various chronic diseases like epilepsy. This study evaluates the impact of fermented composite cereals (Ogi) and its supernatant (Omidun) on the gut of sleep-deprived epileptic rats.

Methods: A composite consisting of 500g each of maize, sorghum and millet were allowed to ferment for 72 hours in water. The same portion of each cereal were soaked individually (non-composite) and allowed to ferment for the same number of hours. The composite and non-composite cereals were wet-milled after fermentation by adding 250g of ginger to the composite only. All the samples were sieved and allowed to further ferment for another 48 hours. Male wistar rats were randomly distributed into five groups of six rats per group. Control (CTRL) received normal saline, epilepsy (EPL) group were kindled using pentylenetetrazol, Sleep deprived (SD)+EPL+Diazepam treatment, SD + EPL + Ogi treatment, lastly SD + EPL + Omidun treatment. Ogi of the composite and non-composite were oven dried at 65oc for 20 hours and packaged properly for chemical analysis including selected minerals and vitamins using standard methods of AOAC. Mean difference between the groups were significant at $p<0.05$. Results: Treatment with composite ogi (residue) and omidun (supernatant) produced an increase in gastrointestinal tract (GUT) Triglycerides levels, low density lipo-protein level, total cholesterol and decrease in high density lipo-protein following kindling in sleep-deprived rats compared with SD and EPL groups. Treatment with diazepam and ogi produced significant reduction in gut Interleukin-17 (IL-17) level. However, treatment with omidun following status epilepticus in sleep-deprived rats did not show any significant difference in gut Il-17 level. The composite ogi contained in (ug/100g) vitamin A (7.23), vitamin D (16.40), vitamin E (13.47), vitamin K (8.67) respectively and for the non-composite ogi, vitamin content in (ug/100g) ranges from (5.81-7.39), (9.83-12.68), (7.67-11.91) and (6.5-11.2).

Conclusion: The composite Ogi was richer in nutrient composition compare to the non-composite and could impact positively on the gut microbiota.

Keywords: Epilepsy, composite, Nutrient composition, Cereals, Probiotics

Conflict of Interest Disclosure: no conflict of interest

PAB(T4)-101
Prebiotics, partially hydrolyzed guar gum, improved the defecation status via changes in the fecal microbiota and short-chain fatty acids in hemodialysis patients

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Background and objectives: Hemodialysis patients frequently complain severe constipation with decreased dietary intake and quality of life. However, increase of vegetable and dietary fiber intake may cause hyperpotassemia in those patients. We hypothesized that some prebiotics improve defecation status with improvement of intestinal environment in hemodialysis patients.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: Fifteen patients received prebiotics as partially hydrolyzed guar gum, 12 g/day that contain 10 g dietary fiber, during four weeks. The defecation status was assessed using both the Bristol Stool Form Scale and the Japanese version of the Constipation Assessment Scale. Satisfaction with prebiotics ingestion was evaluated using a visual analog scale. The fecal status, microbiota measured by a terminal restriction fragment length polymorphism analysis, and fecal short-chain fatty acid concentrations by gas chromatography were compared before and after prebiotics ingestion.

Results: Based on the Bristol Stool Form Scale, some subjects showed extremely disordered properties, such as type 1, separate hard lumps, type 2, lumpy, type 6, mushy stool, or type 7, watery stool, before ingestion. Prebiotics improved the stool form in most subjects to type 3-5, from 60.0% to 66.7%. Type 3-5 stool forms are thought to be ideal in Japan. Prebiotics ingestion also decreased the Constipation Assessment Scale from 5.1 to 3.0. The satisfaction of ingestion increased from 5.8 to 7.3 cm after ingestion. Prebiotics increased the ratio for *Bifidobacterium*, *Bacteroides*, and *Lactobacillales* to 2.4-, 3.2-fold, and 1.9-fold, respectively. Furthermore, the concentration of short-chain fatty acids significantly increased (1.6-fold). The major short-chain fatty acid of acetic acid, propionic acid, and butyric acid increased more than 1.5-fold. After ingestion, total short-chain fatty acids as well as acetic acid and propionic acid showed a positive correlation with *Bifidobacterium*. The individual dendrogram distribution after ingestion was changed in 8 participants (53.3% of the subjects). In 5 participants (33.3% of the subjects), the clusters were even more noticeably different.

Conclusions: Prebiotics improved the defecation status in hemodialysis patients due in part to the composition of intestinal microbiota and short-chain fatty acid concentrations. Improvement of the stool form by prebiotics could relieve constipation, thus improve the quality of life in hemodialysis patients.

Keywords: Hemodialysis, Defecation, Prebiotics, Microbiota, Short-chain fatty acid

PAB(T4)-102
Betaine, a regulator of mitochondrial-endoplasmic reticulum (MAM) interactions in the hepatocyte

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Background and objectives: Interactions between mitochondria and the endoplasmic reticulum (ER), called MAMs, are impaired in the liver of obese mice, with insulin resistance (IR) and steatosis. As certain nutrients can regulate MAMs, we tested whether betaine (a methylated amino acid derived from glycine) could modulate the structure and function of hepatocyte MAMs.

Methods: Primary hepatocytes from Wistar rats (male, 3 months, n=5) were incubated in the presence or absence of betaine (5mM). The structure of MAMs was explored by electron microscopy (TEM) and by in situ proximity ligation assay (PLA) for the functional unit formed by IP3R1 (inositol 1,4,5-trisphosphate receptor) at the ER and VDAC1 (voltage dependent anion channel) at the mitochondrion. Mitochondrial respiration was measured by oxygraphy in permeabilised cells. Gene expression and protein content of key actor at the MAMs (VDAC1, mitofusin 2: Mfn2, chaperone Grp75) were analysed. The results were analysed with Student's t-test.

Results: Betaine promoted MAM integrity vs. control. The length of MAMs measured by TEM relative to the mitochondrial circumference was increased by 4.7 points under betaine vs. control (16.2 vs. 11.5%, $p<0.05$). The number of VDAC1/IP3R1 interactions per nucleus analysed by in situ PLA was increased by 16.7% under betaine vs. control ($p<0.05$). These adaptations were associated with an increase in glutamate (5mM)/malate (2.5mM) cellular respiration (+48%, $p<0.01$). Furthermore, the gene expression and protein content of Mfn2, the protein most commonly found at MAMs, were increased by 26.2 and 15.2% vs. control ($p<0.001$ and $p=0.052$), respectively.

Conclusions: Our results evidenced that betaine regulates the integrity of MAMs. This could be explained by a specific effect on the expression of the structural protein Mfn2. The increase in cellular respiration indicates a beneficial effect of improved MAM integrity on mitochondrial oxidative function.

Keywords: Nutrition, Amino acids, mitochondrial dynamics, liver insulin resistance, liver steatosis

Conflict of Interest Disclosure: The authors report no conflicts of interest in relation to this work.

Further Collaborators: Laureen Jaupart

PAB(T4)-103
Flaxseed Oil Supplement Inhibited Lung Cancer Metastasis via Alpha-Linolenic Acid Regulat

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Background and objectives: In lung cancer therapy, patients usually become weak owing to their severe clinical symptoms or the therapeutic side effects. This lets patients be more willing to use some nutritional supplements as adjuvant therapies; and believing that can help to improve their clinical phenomena. Recently, studies that the tumor growth rate could be significantly suppressed when mice feeding with flaxseed oil. However, the detail mechanism about how flaxseed oil acting in inhibiting tumor progression still remains unclear. As flaxseed oil is composed with approximately 58% alpha-linolenic acid (ALA), one of the essential fatty acids called omega-3 C18 natural fatty

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

acid; and generally, the dietary ALA can be stored in tissues; this let us hypothesize that the anti-cancer activity of flaxseed oil may owing to its good bioavailability from its' component ALA. Here, we conduct a pilot study to systematically dissect the details about the role of ALA supplement in suppressing lung cancer metastasis.

Methods: First, the appropriate dosage of ALA supplements in affecting cancer invasion and migration were determined in vitro by several human lung adenocarcinoma cells (CL1-2, CL1-5, Hop62, and A549), and the normal lung fibroblast (MRC-5) will be used as the control. Further, cell morphological changes and the dynamics of cytoskeleton rearrangement were examined by immunoblotting and immunofluorescence staining. In addition, total proteomic analyses were utilized to reveal the potential mechanism involved in ALA-induced effects on cancer progression.

Results: The results indicated that ALA treatment could induce the occurrence of mesenchymal- epithelial transition in highly invasive lung cancer cells, and have end result in inhibiting cell migratory and invasive abilities.

Conclusions: Our present study may indicate the role of ALA in tumor metastasis and help ensure the chemoprevention is as safe and effective as possible for lung adenocarcinoma patients.

Keywords: Alpha linolenic acid, ALA, metastasis, lung adenocarcinoma, flaxseed oil

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

PAB(T4)-104
Incidence of oral allergy syndrome and pollen allergy in Japanese university students

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Background: Recent reports from various countries demonstrated an increase of oral allergy syndrome (OAS) in patients with food allergy. In addition, OAS is reported to be complicated with pollen allergy. However, the exact prevalence of OAS with pollen allergy has not been well elucidated in adolescents. The aim of the present study is to elucidate the prevalence in Japanese university students.

Methods: Our own self-reported questionnaire was made after discussion among authors who participated in this study. The questionnaire consisted of questions including positivity of food allergy, if positive, main symptoms especially the presence of OAS, causative foods, and the experience of consultation, the positivity of pollen allergy, if positive, possible causative pollen, and the experience of consultation. Participants were students attending to either Ryukoku, Beppu, Hagoromo International or Aichi Shukutoku universities during April and May in 2019. After excluding the incomplete answers, 1100 students (male 418, female 682, mean age 19.1 yr) were enrolled. This study was approved by the ethical committee of Ryukoku University.

Results: (i) Totally, 221(20.1%) students had food allergy. Male showed 14.1% positivity, whereas female showed 23.8% ($p<0.001$). (ii) Among students with food allergy, 21 males (35.6%) and 84 females (51.9%) had OAS ($p=0.032$). (iii) Approximately, half students with food allergy consulted the physicians, and approximately 40 students were diagnosed as food allergy without any sex difference. (iv) Kiwi, melon, pineapple and peach are representative causative foods in OAS. The number of causative foods tended to be higher in females. (v) Totally, 587(53.4%) students had pollen allergy, but there was no sex difference. (vi) The overall rate of complication of OAS and pollen allergy was 80 (7.3%) students.

Discussion: This large scale study on OAS and pollen allergy in adolescents clearly indicates that the prevalence of OAS, and OAS plus pollen allergy is increasing. However, since the number of students who consulted the physicians is limited, a further study is necessary to delineate “true food allergy” from “food hypersensitivity”.

Keywords: Food Allergy, University Students, Oral Allergy Syndrome, Pollen Allergy, Epidemiologic Study

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PAB(T4)-105
Arctium lappa Lam and its related lignans reduce blood glucose and triglyceride levels in diabetic rodent models: Meta-analysis

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Background and objectives: Plant-derived phytochemicals have been interested in as nutraceuticals for preventing onset and progress of diabetes mellitus and its associated complications. *Arctium lappa* L. is a rich source of plant polyphenols with beneficial properties against various diseases including diabetes mellitus. Arctigenin and its glucoside, arctiin, are characteristic lignans in *Arctium lappa* L., whose contents are found to be the highest in Fructus Arctii; these lignans have been studied for their anti-diabetic effects in recent years. Yet, few clinical studies on *Arctium lappa* L. and diabetes mellitus written in English have been reported to this day. Therefore, this study aimed to examine an effect of *Arctium lappa* L. on diabetic hyperglycemia and dyslipidemia by meta-analyzing the current evidence of diabetic rodent models.

Methods and Results: Peer-reviewed studies written in English from two databases, PubMed and Embase, were searched to February 1, 2022. Studies reporting blood glucose or lipid levels in diabetic rodents with and without receiving extracts of *Arctium lappa* L. or its related lignans, are included. Sixteen studies enrolling 160 diabetic rodents treated with extracts of *Arctium lappa* L., and 160 diabetic controls reported blood glucose levels. The pooled effect size was -1.30 (95% CI: -1.65 to -0.94) with a substantial heterogeneity (I^2=66.3%). This effect was, at least in part, modified by types of DM models and

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

doses of arctigenin-related compounds. Moreover, diabetic hypertriglyceridemia was also significantly improved in diabetic rodent models treated with *Arctium lappa* L. Ten studies enrolling 92 diabetic rodents treated with extracts of *Arctium lappa* L., and 92 diabetic controls reported triglyceride levels. The pooled effect size was -1.49 (95% CI: -2.40 to -0.57) with a substantial heterogeneity (I^2=87.3%). This effect was likely to be, at least partially, modified by types of DM models. No effect was observed on HDL-cholesterol levels.

Conclusions: The present meta-analyses demonstrated that blood glucose and triglyceride levels were significantly reduced in diabetic rodent models treated with extracts of *Arctium lappa* L. or its related lignans.

Keywords: *Arctium lappa* L., diabetic rodent models, blood glucose levels, lipid levels, meta-analysis

PAB(T4)-106
Relationship between pancreatic exocrine status and survival in patients with cystic fibrosis in Japan

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Background and aim: Cystic fibrosis (CF) is the most common genetic disease in Europeans. It's very rare in East Asian population including Japanese. Although the median survival time of CF patients is ~24 years in Japan, a small group of patients survive longer. Since the relationship between pancreatic exocrine status and survival is not understood in CF patients in Japan, in this study, we have compared the clinical features of pediatric and adult CF patients.

Subjects and Methods: Fifty patients (23 male and 27 female, 0~47 years old; median age 9 years) with definite CF were evaluated. Fecal pancreatic elastase (PE) was measured by ELISA.

Results: Twenty eight of 38 pediatric (<18 years of age) patients was pancreatic insufficient (PI) (fecal PE < 200µg/g,) and 10 pediatric patients was pancreatic sufficient (PS) (fecal PE ≧ 200 μg/g). Two of 12 adult (≧18 years of age) patients was PI and 10 adult patients was PS. These 10 adult PS patients had chronic pulmonary disease or high levels of sweat [Cl^-] (≧60 mmol/L). The ratio of PI and PS was significantly different between pediatric and adult patients (p<0.01).

Conclusion: These data suggest that the existence of PI is one of the risk factors for mortality of CF patients in Japan. Malnutrition caused by pancreatic insufficiency is known to be related to impaired lung function. Intensive nutritional management is necessary to improve nutritional status and survival.

Keywords: Cystic fibrosis, Pancreatic insufficiency

PAB(T4)-107
Ad libitum dietary intake in young people with craniopharyngioma: a feasibility study of eating behaviour

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Background and objectives: Craniopharyngiomas are rare benign suprasellar tumours near the pituitary-hypothalamus region. Obesity often results from surgical and/or radiotherapy treatment or due to the tumour itself. Mechanisms leading to obesity, hyperphagia and altered energy homeostasis are largely understudied. The aim was to assess the feasibility of measuring energy and macronutrient intake of patients with craniopharyngioma and control participants using an *ad libitum* buffet-style meal.

Methods: Participants attended the research facility once, accompanied by a parent/guardian after an overnight fast. They underwent tests relevant to eating behaviour followed by an *ad libitum* lunch comprised of hot, cold, sweet, savoury, food and beverages. Each item was covertly weighed before and after the lunch was served. Lunch provided ~30MJ and 37, 49 and 11% energy from fat, carbohydrate and protein, respectively. Patients and controls ate alone, remained in a room for approximately 30 minutes and were asked to eat to appetite. Data are presented as mean and standard deviation (sd). Hedge's g was used to measure effect size (*g*) between the two groups.

Results: Eleven patients (5F/6M) with childhood-onset craniopharyngioma age 15(4.6)y, BMI SDS 1.2(1.9) and 11 controls (5F/6M) matched for age and pubertal stage, 15(4.9)y, BMI SDS -0.62(0.9) took part. One control participant did not consume lunch due to previously undisclosed allergies. The remaining participants reported acceptability of the lunch. Lunch intake was 4.79(1.92) and 4.93(1.6)MJ, 51(21) and 53(17)g fat, 138(57) and 135(55)g carbohydrate and 29(15) and 34(11)g protein by patients and controls, respectively. When intake was expressed as a percentage of total energy, patients consumed more carbohydrate (*g*=0.42) and less fat and protein than controls (*g*=0.26, *g*=0.58, respectively).

Conclusions: These preliminary results demonstrate the acceptability and usability of *ad libitum* lunch methodology to assess energy and macronutrient intake in childhood-onset craniopharyngioma. These data are a subset examining eating behaviour in this patient group and given that hyperphagia and obesity in children and young people with craniopharyngioma causes substantial personal and parental distress, this highlights the importance of further investigation with a view to the development of future novel interventions.

Keywords: Craniopharyngioma, Feasibility, Ad libitum, Eating behaviour, Obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-108
Low-carbohydrate diet containing plant-derived fat ameliorate heart failure via PPARα activation

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Background and objectives: Cardiovascular disease (CVD) is a global health burden that could be prevented by dietary intervention. Although low-carbohydrate diets (LCDs) have beneficial effects on CVD risk factors (obesity, diabetes, dyslipidemia, and hypertension), their preventive effects on CVD remain elusive. Recent clinical studies have suggested that the effects of LCDs depend on the difference of macronutrients replaced for carbohydrate. We aimed to investigate whether LCDs with animal-derived fat (LCD-A) or plant-derived fat (LCD-P) ameliorate heart failure (HF) using a murine model of pressure overload.

Methods: Using wild-type male mice, we performed transverse aortic constriction surgery to generate a pressure overload model of HF. Mice were subjected to either control standard diet, LCD-A or LCD-P for 4 weeks and cardiac function was evaluated by echocardiography. Based on RNA-sequencing results from mouse hearts, we used cardiomyocyte-specific peroxisome proliferator-activated receptor alpha (PPARα) conditional knockout mice and pemafibrate, a selective PPARα modulator, for loss- and gain-of-function experiments to elucidate the roles of PPARα in HF development. We also examined the fatty acid composition in the sera and hearts of LCD-fed mice and tested PPARα activation by fatty acid in cultured cardiomyocytes.

Results: LCD-P ameliorated HF progression, while LCD-A aggravated inflammation and cardiac dysfunction. In hearts of LCD-A-fed mice, inflammation-related and cell cycle-related gene expressions were upregulated. On the other hand, fatty acid oxidation-related genes were highly expressed in the hearts of LCD-P-fed mice, and PPARα, which regulates lipid metabolism and inflammation, was activated. After pressure overload, cardiomyocyte-specific *Ppara* conditional knockout mice exhibited more severe cardiac dysfunction and inflammation than control mice, which was not inhibited by feeding LCD-P. However, pemafibrate ameliorated pressure overload-induced cardiac dysfunction and inflammation in wild mice. Stearic acid, which was more abundant in the sera and hearts of LCD-P-fed mice, activated PPARα target genes in cultured cardiomyocytes. PPARα target gene expression reduced by phenylephrine, which is known to induce cardiomyocyte hypertrophy, was restored by stearic acid stimulation.

Conclusions: Our study highlights the importance of substituting fat sources for reduced carbohydrates in LCDs and suggests the LCD-P-stearic acid-PPARα pathway as a novel therapeutic target for HF.

Keywords: Low-carbohydrate diet, Plant-derived fat, Heart failure, PPARα, Stearic acid

PAB(T4)-109
Effects of dehulled adlay on modulating nonalcoholic fatty liver disease

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Background and objectives: Nonalcoholic fatty liver disease (NAFLD) is the most common liver diseases worldwide and diet modification may be useful in retarding the progression of NAFLD. Adlay and its bran was reported to show potential in anti-oxidant and anti-inflammatory activity. Thus, the aim of this study was to investigate the effects of dehulled adlay on modulating NAFLD.

Methods: 24 male Sprague-Dawley (SD) rats were randomly divided into control group (C), NAFLD group (N) and NAFLD + adlay group (NA) for a 16-week experimental period. Rats in control group were fed with chow diet. N and NA group were fed with a high-fat-high-sucrose (HFHS) diet with or without dehulled adlay powder.

Results: At the end of the study, we found no significant difference in body weight among groups, but both N and NA group had more significant fat accumulation in the liver. We also found that NA group showed less steatosis and had higher GSH/GSSG ratio than the N group. Although the expression of the toll-like receptor 4 (TLR4) and myeloid differentiation primary response 88 (Myd88) in N and NA group were lower than C group, no difference in hepatic pro-inflammatory cytokines and circulatory endotoxin levels among groups were found. In the analysis of gut microbiota, Firmicutes/Bacteroidetes ratio (F/B ratio) and the abundance of *Actinobacteriota, Verrucomicrobiota, Clostridia, Clostridium* was higher in both groups fed with HFHS diet. In addition, *Clostridiaceae* in group NA were more abundant than in group N.

Conclusions: Our result suggested that ingesting dehulled adlay as part of the diet may improve liver steatosis, oxidative stress modulating gut microbiota.

Keywords: NAFLD, dehulled adlay, steatosis, gut microbiota

PAB(T4)-110
Fatty acid biomarkers of dairy fat consumption, gut microbiome and cardiovascular health

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Background and objectives: To investigate the prospective associations of circulating odd-chain fatty acids (OCFA) pentadecanoic acid (15:0) and heptadecanoic acid (17:0), as

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

biomarkers of dairy fat intake, with gut microbiome. We further examined whether the gut microbiome could modify the association between OCFA and cardiovascular health.

Methods: We measured the baseline plasma OCFA of 1220 participants from the Guangzhou Nutrition and Health Study. The gut bacterial and fungal composition over a median follow-up of 6.9 years were profiled using 16S rRNA (n=1129) and ITS2 (n=720) sequencing, respectively. The carotid intima-media thickness (IMT) and carotid artery plaques (CAPs) at follow-up were determined by ultrasound examination. Using multivariable-adjusted linear regression analyses, we examined the associations between OCFA and gut microbiome features. We further explored the interaction between OCFA and gut microbiome on host cardiovascular disease risk.

Results: After adjustment for potential confounders, higher levels of 15:0, 17:0 and their sum were positively associated with a higher gut bacterial α-diversity, while negatively associated with the fungal α-diversity. The overall gut bacterial composition, but not fungal composition could be distinguished by the levels of OCFA (all p=0.001). Specific taxonomic components, such as *Prevotella 9*, *Butyricimonas* were enriched in individuals with the higher levels of plasma OCFA. Furthermore, we observed that the protective associations between 17:0 and carotid IMT and plaques varied depending on the microbial abundance. In particular, elevated levels of 17:0 was associated with lower incidence of CAPs (RR=0.74, 95% CI: 0.59-0.93) in participants with lower abundance of *Alistipes* (p<0.05), but not in high-abundance *Alistipes* carriers.

Conclusions: Plasma levels of odd-chain fatty acids (15:0, 17:0) were associated with gut bacterial and fungal community. The gut microbiome might modify the interaction between dairy fat biomarkers and cardiovascular health.

Keywords: Odd-chain fatty acids, Gut microbiome, Population-based cohort study, Cardiovascular health

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T4)-111
The relationship between dietary calorie intake in the Medicine ICU first week and the prognosis within 28 days

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Nutritional support to critically ill patients' is very important for medical treatment, especially in the first week of intensive care unit (ICU). The accumulated energy unbalance at the end of the first week of ICU is a strong predictor of prognosis. Aim: This study's purpose is to investigate the relationship between the calorie and protein intake in the Medical ICU first week and the prognosis within 28 days of a regional teaching hospital in northern Taiwan. Study design: A retrospective observational study was conducted on patients, aged 20-80 years, admitted to the Medical ICU of Sijhih Cathay General Hospital from 2018/01/01 to 2020/12/31 and we obtained patients' data from hospital information system (HIS system). We divided ICU patients into ≧ 60% energy group (≧ 60% ε) and & <60% energy group (<60% ε) of calorie requirement according to their actual caloric intake in first ICU week. We analyzed their 7 days, 28 days mortality of those patients. Results: It is significant higher 7 days mortality in <60 % ε group than ≧ 60 % εgroup. Conclusion: Early nutritional care in ICU is extremely important and we recommend that to maintain patient's caloric intake at least 60% energy requirement.

Keywords: nutritional support, intensive care unit, dietary calorie, mortality

PAB(T4)-112
Ketogenic Diet Therapy (KDT) and Nutritional Status in a Glut 1 Deficiency Syndrome (G1DS) Chilean Cohort

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Background: GLUT1DS is an early onset childhood epileptic encephalopathy caused by impaired glucose transport across the blood brain barrier with subsequent brain energy failure symptoms, primarily seizures, cognitive impairment, and movement disorders. Since its initial description in 1991, the number of affected individuals has increased with age specific symptoms across lifespan. KDT has been proven as an effective treatment that should be initiated as early as possible, providing the developing brain with alternative metabolic fuel (ketones).

Objective: Describe anthropometric and biochemical status of patients with GLUT1DS on KDT.

Methods: Medical records of all patients on our GLUT1DS follow-up program were reviewed. Patients were appointed for anthropometric and biochemical evaluation. Lipid profile, serum ferritin and 25OHvitD was obtained. Insufficient D vitamin status was defined with levels between 20-30ng/ml and deficiency with levels below 20ng/ml. In children <5y, weight for length(WFL)z-score were used for anthropometric evaluation, in >5y, BMIz-score was used. Height adequacy was evaluated with height for age (HFA)z-score.

Results: 20 patients (11 male), with a median age of 7.9y who had been on KDT for a median of 2.7y (range 3m-21y) were evaluated. All of them with adequate supplementation. In 9 subjects, KDT was initiated within the first 7d since diagnosis; 9 were started within 1m and only 2 were started at 3m since diagnosis due to family issues. After KDT initiation, all patients responded with >50% reduction of seizure activity, 12 of them becoming seizure-free. However, accurate diagnosis was delayed

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

a median of 3y since the first seizure episode (range 15d-13y). Ratio of KDT was between 2-2.7:1 in 11 subjects; 3 were following a MAD diet, 3 had a ratio of 1.5:1 and 2 had a ratio >3:1. Ketone levels (BOHB) were between 0,5-2 mmol/lt in MAD diet users, and between 2-3.9 mmol/lt in the rest of subjects. Six patients were classified with normal weight, 8 with overweight, 3 with obesity and 2 underweight. Two patients had short stature (z-score: -2.65 /-2,4). All subjects had normal iron deposits. Three subjects had insufficient vitamin D levels and 3 had deficiency status. 4 patients had elevated LDLc (range 116-130 mg/dl), 3 had low HDLc (34-38 mg/dl) and 4 had elevated triglycerides (137-165 mg/dl).

Conclusions: KDT is an effective nutritional medical therapy for GLUT1DS which renders a good seizure control with limited impact on micronutrient status and low risk of undernutrition.

Keywords: Ketogenic diet, GLUT 1 Deficiency Syndrome

PAB(T4)-113
Differences in urinary phosphorus excretion after animal or plant protein intake in healthy young Japanese women

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Background and objectives: Among patients with chronic kidney disease undergoing dialysis, phosphorus intake needs to be reduced while maintaining the necessary consumption of protein. However, it is known that phosphorus and protein content in foods are correlated, thus dietary planning that balances protein consumption while restricting phosphorus intake is a difficult issue. Urinary phosphorus excretion is known to be reflective of phosphorus absorption. Therefore, in this study, we investigated the effect of dietary intervention with animal, plant, or restricted protein intake on phosphorus excretion by analyzing 24-hour collected urine and dietary surveys.

Methods: Healthy young Japanese women were divided into four groups: normal (no dietary intervention), animal (animal protein sources), plant (plant protein sources), and low-protein (protein restriction), and were subjected to a 3-day dietary intervention. Vegetable intake was limited in the animal, plant, and low-protein groups to eliminate the effects of their constituent minerals. Based on the 3-day dietary records and 24-hour collected urine on day 3 of the intervention, the nutritional value, food group intake, and urinary components were evaluated.

Results: There were no significant differences in the protein and phosphorus intake between the normal, animal, and plant groups. However, urinary phosphorus excretion was significantly lower in the plant and low-protein groups than that in the normal and animal groups; there was no significant difference between the plant and low-protein groups, with similar levels of phosphorus excretion. The primary protein source for the plant group was soy products, therefore, legume intake was significantly higher in the plant group compared to the other groups. Furthermore, soybeans are high in magnesium, thus, the plant group also showed significantly higher magnesium intake than the other groups.

Conclusions: We showed that the plant protein diet reduced urinary phosphorus excretion to levels similar to that of the protein-restricted diet, while ensuring the protein intake was comparable to that of the animal protein diet. We hypothesize that phytin and magnesium, which are related to the form of phosphorus in foods, are the factors that may explain these findings. Plant protein may therefore be useful for phosphorus limitation while maintaining adequate protein intake.

Keywords: Phosphorus, protein, 24-hour collected urine, dietary intervention, soy product

Conflict of Interest Disclosure: no conflict of interest

Further Collaborators: none

PAB(T4)-114
Maternal consumption of eggshell membrane during pregnancy and lactation influences offspring colitis symptoms and dysbiosis in mice

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Background and objectives: Dietary habits can affect the gut microbial community, thus influencing disease susceptibility in offspring. Although the effects of maternal nutritional status on offspring development have been documented, much less is known regarding the effects of maternal functional food consumption on offspring. Our previous study suggested that eggshell membrane (ESM) consumption could inhibit intestinal inflammation against inflammatory bowel disease (IBD). In this study, we further explored the effects of maternal ESM consumption during pregnancy and lactation on the gut inflammation, microbial structure, and composition in interleukin-10 knockout (IL-10 KO)-induced IBD offspring mice.

Methods: The pregnant mice were divided into three groups (WT: wild type C57BL/6J mice, basal diet; KO: IL-10 KO mice, basal diet; KOE: IL-10 KO mice, 8% ESM diet during pregnancy and lactation). The female pups were kept with their own mothers until postweaning to receive basal diet conditions. After 61 weeks of treatment, transcriptome analysis and microbiota analysis were performed on IL-10 KO-induced IBD offspring mice.

Results: Administration of ESM significantly increased the body weight of female offspring mice. Gene profile results indicated that with maternal ESM consumption, the female offspring mice exhibited enhanced serum response factor (Srf) expression which might assist in keeping normal macrophage phagocytosis to improve inflammation conditions.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Concomitantly, microbiota analysis established an essential role of ESM in improving dysbiosis characterized by affecting the relative abundance alterations of bacteria composition including reductions in immune-related Parapedobacter, Gramella, Parabacteroides distasonis, increased Muricauda as well as increased organic acid concentration especially enhanced butyrate to protect against IL-10 KO-induced microbiota dysbiosis cooperatively.

Conclusions: Our findings provided evidence that ESM serving as a maternal functional food contributes to the improvement of offspring colitis symptoms and dysbiosis in mice, which provides new perspectives from maternal dietary consumption for preventing the development of offspring colonic inflammation. Further investigation is needed to demonstrate the impact of the maternal gut microbiota, as well as short-chain fatty acids, on embryonic development and disease susceptibility late in life.

Keywords: Eggshell membrane, Inflammatory bowel disease, Offspring, Gut microbial, Short-chain fatty acids

Conflict of Interest Disclosure: Y.H. is working as a researcher in ALMADO Inc. in Tokyo. All other authors declare no conflict of interest.

PAB(T4)-115
Effectiveness of Mediterranean diet on daytime sleepiness among individual with type 2 diabetes mellitus in Oman

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Background: Excessive daytime sleepiness is a major complaint among individual with diabetes mellitus, which may be augmented with dietary intervention. The objective of this randomized controlled trial was to determine the effectiveness of Mediterranean diet intervention on daytime sleepiness among Type 2 Diabetes Mellitus (T2DM) patients in Oman.

Methods: A total of 134 eligible T2DM patients (61 and 73 respondents in the intervention and control group, respectively) were recruited. The intervention respondents underwent a six-month Mediterranean diet intervention comprising of individual dietary counselling, cooking classes, phone calls and social media messages while the control group continued with standard diabetes care. Daytime sleepiness was assessed using the Epworth Sleepiness scale. All data were analyzed using SPSS.

Results: Approximately 30% of the respondents experienced daytime sleepiness, with no significant difference between control and intervention respondents at baseline. There was significant reduction in daytime sleepiness in both intervention and control groups after 6 months, with daytime sleepiness was significantly lower in the intervention respondents, at a modest difference of 42.56% ($p < 0.001$).

Conclusion: Adherence to Mediterranean diet is effective in reducing daytime sleepiness among individual with T2DM.

Keywords: Mediterranean diet, Daytime sleepiness, Diabetes mellitus

PAB(T4)-116
Effects of muscle mass retention in morbidly obese patients after bariatric surgery on body composition in different genders in Taiwan

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Background and objectives: Bariatric surgery is an effective method to control morbid obesity. The number of sleeve gastrectomy (SG) has increased recently. Their body weight can be decreased rapidly in the first 3 months, especially lean body mass. Muscle mass retention and intervention rate are important for patients who want to lose weight. This study aims to investigate the association between body composition and follow-up rate in patients with sleeve gastrectomy.

Methods: A retrospective clinical study conducted in Taipei Medical University Hospital, Taiwan. This study included 1062 morbid obese patients who have been SG for enrollment from 2010 to 2014. The final follow-up was in 2019 (TMU-JIRB201203002). Patients needed to measure body weight, muscle mass, fat mass, and waist-hip ratio (WHR) before and after surgery using BIA measurement. After surgery, a registered dietitian visited the patients, and gave the diet recommendations based on ASN and ASMBS guidelines. The interventions include counseling (15 sessions in 5years) and modification on dietary, physical activity, and behavioral approach in visit time.

Results: Of 1062 patients (713 [67.1%] women; mean age 35.3±9.1 years, weight 112.3±23.6 kg, BMI 40.4±6.8 kg/m^2, length of stay 3.9±1.2 days). Data showed that body weight, body fat mass and WHR significantly decreased within a year (weight between male(M) and female(F): 91.8±17.7kg, 73.5±12.9kg), and to third year (M and F: 92.8±22.1kg, 73.0±12.6kg), by the end of fifth year body weight increased (M and F: 100.6±17.7kg, 75.2±11.6kg). Patients with lower change in muscle mass positively related to weight maintenance. Compared the follow-up rate and body composition, patients with higher follow-up rate showed a trend on higher change in body weight.

Conclusions: The present study suggests that higher weight loss in the first 3-months, especially combined muscle mass retention, and a more follow-up rate relates to better weight loss.

Keywords: Body composition, Lean body mass, diet management, morbid obesity, bariatric surgery

Conflict of Interest Disclosure: I have no conflict of interest to report.

Further Collaborators: I have no further collaborators to report.

PAB(T4)-117
Optimal protein intake for inpatients with type 2 diabetes

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Background: In the previous study, we demonstrated that a one-week diet of 25 kcal x ideal body weight (IBW) to inpatients with type 2 diabetes resulted in significant weight gain in the underweight group (BMI <18.5 kg/m^2) and significant weight loss in the overweight group (BMI> 25.0 kg/m^2). However, we did not investigate whether this is due to the increase or decrease in muscle and fat.

Methods: We performed a Randomized Controlled Trial on patients in diabetes educational admission. Men and women over the age of 20 with type 2 diabetes and without renal dysfunction were randomly assigned to the standard-protein group (1.0g x IBW <= protein <1.3g x IBW) or the high-protein group (1.3g x IBW & <= protein <=1.6g x IBW). All participants were provided with a diet of 25 kcal x IBW for one week. In addition, an average of 3.4 Exercise/day rehabilitation was performed in both groups. During hospitalization, their blood glucose was corrected with intensive insulin therapy. A body composition analyzer (InBody®) was used to measure muscle and fat mass. The primary endpoint was the changes in muscle and fat mass (rate) between the two groups. The secondary endpoint was the amount of protein that changes muscle mass (rate) from decreasing to increasing.

Results: From March 2021 to March 2022, twenty-seven patients who met the eligibility criteria participated in this study. After one week of intervention, the change in muscle mass (rate) was +0.3 kg (+1.0%) and fat mass (rate) was -1.3 kg (-6.0%) in the standard-protein group. The change in muscle mass (rate) was +1.9 kg (+4.9%) and fat mass (rate) was -4.1 kg (-22.6%) in the high-protein group. Compared with the standard-protein group, a significant increase in muscle mass (P =0.04) and a decrease in fat mass (P < 0.001) were observed in the high-protein group. The protein intake at which muscle mass changed to increase was 1.2 g x IBW.

Conclusion: It was demonstrated that a large amount of protein diet (> 1.2 g x IBW) to patients with type 2 diabetes in educational hospitalization significantly increased muscle mass and decreased fat mass.

Keywords: Type 2 diabetes, Protain, Muscle mass, Fat mass, Inbody

PAB(T4)-118
Effect of Japanese fermented rice malt beverage on defecation status in home-care patients with disabilities including severe motor and intellectual disabilities

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Background and objectives: Constipation is a frequent complication in patients with severe motor and intellectual disabilities (SMID), therefore it is important to monitor the defecation status on a daily basis. The aim of this study was to investigate changes in defecation status associated with the intake of a Japanese fermented rice malt beverage (FRMB) in home-care patients with disabilities including SMID.

Methods: Ten patients (6.9 ± 5.6 years old, four males, six females) consumed FRMB (35 g/day) for six weeks and their physical condition, dietary and medication status, and defecation status, including constipation assessment scale (CAS), Bristol stool scale (BSS), and flowchart to classify defecation patterns of revised version (FCDP-RV) were investigated. For CAS, the score rate was calculated. Patients with a score of 31.3% or higher were evaluated as constipation-prone.

Results: CAS showed a decreasing tendency from 25.6 ± 13.0% to 13.8 ± 15.5% after the intervention (p = 0.064). BSS was classified into three categories: hard stools (type 1-2), normal stools (type 3-5), and soft stools (type 6-7), and the percentage of the three categories of BSS in the frequency of defecation during the week before the intervention and the sixth week was analyzed. The results showed a decreasing tendency in hard stools from 21.0 ± 34.7% to 8.1 ± 21.1% (p=0.066) and a significant increase in normal stools from 28.6 ± 22.6% to 54.1 ± 31.4% (p= 0.038). FCDP-RV is a tool for classifying defecation patterns into six categories based on stool shape and defecation days, and the percentage of patients falling into each category was examined. Diarrhea class, Observation-required class, and Constipation I class decreased from 30% to 10%, 10% to 0%, and 20% to 10%, respectively, and Constipation II class and Normal class increased from 0% to 20% and 30% to 50%, respectively.

Conclusions: After six weeks of FRMB intake in home-care patients with disabilities including SMID, changes in CAS suggested the possibility of reducing constipation symptoms. This may be accompanied by a change in stool shape. However, further validation with a larger sample size and a control group is needed.

Keywords: Fermented rice malt beverage, constipation, defecation status, patients with severe motor and intellectual disabilities

PAB(T4)-119
Effect of dietary intake and training of heavyweight male athletes on blood ALT and γ-GTP

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Background and objectives: Heavyweight athletes may eat more and strain the liver in order to grow larger. In addition, the accumulation of fatigue from daily training can lead to a chronic decline in liver function. Therefore, among athletes, heavyweight athletes are considered to have a high risk of decreased liver function. However, few studies have objectively observed diet and training as factors that influence blood test data, which is an indicator of liver function, and no conditioning method has been established for athletes to restore liver function. Therefore, in this study, we decided to analyze in detail the factors related to the deterioration of blood test intake status, physical activity, liver function, and blood test data of track and field thrower and judo heavyweight athletes.

Methods: The subjects were 20 college students track and field thrower and 9 college students judo heavyweight (90 kg or more). We performed body composition measurement using impedance method, training survey, semi-quantitative diet survey for 3 days, and blood test.

Results: Examination of blood test data and influencing factors showed that there was a positive correlation between carbohydrate intake and ALT, energy ratio and triglyceride in blood in track and field thrower (r = 0.478, r = 0.519). There was a positive correlation between the amount of physical activity of track and field throwers and judo heavyweight athletes and γ-GTP (r = 0.605, r = 0.712).

Conclusions: For heavyweight athletes, it was suggested that excessive consumption of energy, especially carbohydrates and overtraining may synergistically worsen liver function. From this, it was considered necessary to adjust the dietary balance and the amount of training in order to improve liver function.

Keywords: ALT, γ-GTP, Track and field thrower, Judo, Meal

PAB(T4)-120
The effect of healthy eating index for hemodialysis patients on body composition

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Background: Dietary quality is an important factor to maintain the body composition which may further improve the clinical outcomes in hemodialysis patients. Health eating index for hemodialysis (HEI-HD) is established of 16 items include nutrient and food for hemodialysis patients in 2020. Aim: To investigate the relationship between dietary quality and body composition in hemodialysis patients.

Study design: A quasi experimental design was conducted in the four hemodialysis centers in northern Taiwan from May 2019 to April 2021. Total 94 subjects were included for analysis. Muscle and fat mass were assessed by bioelectrical impedance analysis and dietary quality was assessed by HEI-HD.

Results: The mean age, HEI-HD score, skeletal muscle mass (SMM) and appendicular skeletal muscle mass (ASM) of the subjects was 58.3 ± 10.1 years, 65.6 ± 8.3, 26.3 ± 5.7 kg, 19.4 ± 4.7 kg, respectively. The results of linear regression showed that the HEI-HD score, and total protein were positively correlated with SMM/Wt and ASM/Wt. The HEI-HD score was negatively associated with body fat mass, body fat percentage, and visceral fat mass. We divided subjects into 2 groups according to the median of SMM/Wt 40.53%, analyzed the binary logics regression model with the generalized estimating equation showed that with one piont increment of total protein, the risk of low muscle mass reduced by 12%.

Conclusion: It is recommended to use HEI-HD to evaluate the dietary quality of hemodialysis patients. Promoting dietary quality is highly suggested to improve the patient outcomes.

Keywords: Hemodialysis, dietary quality, body composition, total protein foods

PAB(T4)-121
An increase in enterohepatic 12α-hydroxylated bile acid circulation alters iron balance in an early phase and induces subsequent stable reduction of hepatic iron concentration in rats

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Background and objectives: We previously found an increase 12α-hydroxylated (12αOH) bile acids (BAs) correlates liver triacylglycerol in rats fed a high-fat diet, and a cholic acid (CA)-supplemented diet develops simple hepatic steatosis. The CA feeding markedly reduced the hepatic iron concentration without change in food intake. In this study, we compared iron balance between the rats fed CA-supplemented diet and marginal iron deficiency (MID) diet to understand iron homeostasis.

Methods: WKAH/HkmSlc male rats (3-week-old) were divided into four groups, and fed either a control diet, a diet supplemented with CA (0.5 g/kg diet), a diet with a half concentration of iron in AIN-93G-based mineral mixture (MID), or diet in combination with CA and MID for two weeks. We measured iron balance and hepatic iron concentration. Also,

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DOI: 10.1159/000530786

iron-related parameters and hepatic gene expressions were analyzed.

Results: As shown in our previous study, CA diet specifically reduced hepatic iron concentration also in the 2-week study. Notably, CA diet enhanced fecal iron excretion, but such enhancement was not observed in our previous 13-week study. On the other hand, reductions were found in hepatic iron concentration, hematocrit, and aortic plasma iron parameters in MID-fed rats regardless of no difference in iron balance. Also, there was no anemia-related symptoms, such as reduction of food consumption, body weight, and whole blood hemoglobin concentration in MID-fed rats. In gene expression analysis, there were significant differences in iron transporters in MID-fed rats, but such difference was not observed in CA-fed rats. These results suggest that an increase in enterohepatic 12αOH BA circulation selectively reduces hepatic iron concentration by alteration of iron balance in the early phase. The mechanism underlying in this condition is obviously different from that in MID-fed rats.

Conclusions: Sufficient energy intake induces an increase in 12αOH BAs, which is possible to reduce hepatic iron concentration selectively by enhancement of iron excretion in an early phase. Such a liver-specific reduction of iron concentration may be involved in liver-specific lipid accumulation.

Keywords: Bile acid, Iron balance, Liver lipid accumulation, Marginal iron deficiency, Rats

PAB(T4)-122
The effect of dietary fat quality on cardiovascular disease risk factors in hemodialysis patients

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Background and objectives: Cardiovascular disease (CVD) is the most common complication in hemodialysis (HD) patients. The dietary cholesterol-saturated fat index (CSI) is a measure of dietary fat quality and is associated with CVD risk in obese patients. The aim of this study was to investigate the correlation between CSI and CVD risk factors in HD patients.

Methods: A quasi-experimental design was conducted in the four hemodialysis centers (one group in one center) in northern Taiwan from May 2019 to April 2021. The educational handbook is given to both subject patients and nurses, and the Non-C group is not given nutrition education courses; Nutrition education for nurses in the CN group; nutrition education for patients in the CP group; nutrition education for nurses and patients in the CPN group. We collected the patient's characteristics, biochemical parameters, dietary intake. The CSI value was calculated. A total of 119 HD patients were included in the analysis.

Results: It showed that in comparison with the Non-C group, the CP group had significantly improved CSI, serum total cholesterol, homocysteine, and albumin. CSI was positively correlated with serum total cholesterol and high-sensitivity C-reactive protein.

Conclusions: Nutritional education could improve patients' dietary fat quality, and CVD risk factors. CSI could be used as a predictor of serum total cholesterol and high-sensitivity C-reactive protein.

Keywords: Cardiovascular disease, Dietary fat quality, Dietary cholesterol-saturated fat index (CSI), Nutritional education

PAB(T4)-123
The effects of adapted renal dietary guidelines on adherence in hemodialysis patients

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Background: Renal dysfunction and chronic kidney disease (CKD) is known to affect as much as 10% of the population worldwide.[1] The annual mortality rate of hemodialysis patients is as high as 20%, with poor nutritional status being one of the biggest influencers of poor outcomes.[2] There is currently an increased awareness of the importance of optimal nutrition and early intervention to address malnutrition.[3] Despite the known advantages of nutritional intervention for dialysis patients, the CKD diet remains one of the most complex therapies to teach, understand and moreover, adhere to. Better adherence may be achieved by adapting and simplifying the dialysis patient's dietary prescription.[4] This study assessed whether simplifying the current renal dietary guidelines would have a positive effect in terms of patient adherence to the dietary guidelines and improve nutritional status.

Methods: A Quasi-experimental study including 75 hemodialysis patients from 4 dialysis units in Pretoria, South Africa. Adult hemodialysis patients undergoing dialysis 3 times per week between the ages of 18–70 years were included. Each participant's nutritional status was determined using anthropometrical measurements (body mass index (BMI)), waist circumference, triceps skinfold, mid-upper arm circumference (arm muscle area (AMA)) and biochemical parameters. Dietary intake was determined using a food frequency questionnaire (FFQ). Statistical tests were performed to analyse the stated objectives.

Results: Seventy-five participants were enrolled; 42 participants in the intervention group and 33 in the control group. The mean age of the population was 55 years (± 10.90). Fifty-five of the participants (73%) have been on dialysis for longer than 2 years. In terms of gender, 52 (69.33%) of the study population were male and 23 (30.67%) female. The majority of participants were well educated with a high household income. The most prevalent chronic illness reported was hypertension in

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

66 (88%) of the participants. The average BMI of the population at baseline was 26.6kg/(m²) (± 5.40) with 42 (56%) participants being overweight or obese. The majority of participants, 52 (69.33%), presented with an average AMA. The average protein intake of the group was within the recommendation at 1g/kg/day. The population showed a high intake of saturated fats and refined sugar. The average fiber intake was 20.68g/day (± 10.86), which is lower than the recommendation of 25g/day. An improvement in adherence to the renal dietary guidelines was seen in all aspects in both the intervention and the control group. After the intervention, the total adherence for the population improved by 15%, although adherence remained poor in terms of fruit, vegetables and fiber intake. When comparing the improvement in adherence to the renal dietary guidelines between groups, no statistically significant difference was found between the traditional vs simplified guidelines (p = 0.341).

Conclusion: Both the control and the intervention group received in-depth dietary education which might explain an equal improvement in terms of adherence. Given the high prevalence of overweight and obesity in end-stage renal disease, the management thereof should form an integral part of the nutritional intervention. Further intervention should focus on weight loss and increasing fruit, vegetable and fiber intake.

Keywords: Nutritional assessment in chronic kidney disease, adherence to renal dietary guidelines, simplifying renal dietary guidelines

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T4)-124
Hyperinsulinemia- An early marker to detect risk of metabolic dysfunction and prediabetes in adolescents and young adults in India

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Background and Objectives: Hyperinsulinaemia in the absence of impaired glucose tolerance and normal HbA1c may provide the earliest detection for metabolic disease risk and is considered indicative of pre-diabetes or occult diabetes. Very few Indian studies have focused on hyperinsulinemia particularly in adolescents and young adults. The present study examined the fasting and 2-hour stimulated glucose and insulin levels vis-à-vis their glycosylated hemoglobin levels in adolescents and young adults (16-25 years of age) living in Mumbai, India.

Methods: The study screened 1313 subjects in the age group of 16-25 years for Height, Weight, BMI, Waist Circumference, Body Fat percentage , Fasting and 2 hour blood glucose and insulin levels and glycosylated haemoglobin using standardized techniques.

Results: Among this young population (n=1313), 4.2% (n=55) of the participants were found to be prediabetic by ADA criteria and 19.7% of the participants were found to have HbA1c levels between 5.7%-6.5%. However, almost, 30.5% of adolescents had hyperinsulinemia in spite of normal blood glucose levels. Among those with normal HbA1c (<5.7), 56 participants had fasting insulin> 15 mIU/L and a higher percentage of participants (39.4%, n=260) participants had stimulated insulin above 80 mIU/L. Among those with normal HbA1c, mean values for BMI, WC, WHtR, percent body fat as well as visceral fat were significantly higher when their fasting and/or stimulated insulin was high as compared to those with normal fasting and/or stimulated insulin, whereas muscle mass was lower.

Conclusions: These findings highlight the need to use insulin levels as a screening tool along with commonly used blood glucose markers in young population, particularly for the overweight/obese who may beat-risk of progressing to diabetes in near future.

Keywords: Hyperinsulinemia, Glycosylated Haemoglobin, Prediabetes, Adolescents, Young adults

Conflict of Interest Disclosure: No conflict of Interest

Further Collaborators: Not applicable

PAB(T4)-125
High Protein and Ready-to-eat Rice for Elderly with Dysphagia

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Background and objectives: Singapore is facing an increase in ageing population with dysphagia a growing concern. Study showed that one in two Singapore people aged 50 and older do not meet the daily protein requirement. Additionally, about 15% of the Singapore elderly population is affected by swallowing difficulty. Dysphagia in the elderly population is associated with increased risk of malnutrition and pneumonia. Traditionally, rice has been a staple food for people in Singapore and across Asia. At present, dysphagia friendly protein fortified ready-to-eat cooked rice is not available in the local food market. This project aimed to produce high-protein and ready-to-eat rice suitable for the community elderly especially those with dysphagia.

Methods: For swallowing safety, a highly efficient size reduction machine Comitrol® Processor Model 1700 was used to size reduce the rice into consistent size that meets the International Dysphagia Diet Standardization Initiative (IDDSI) Level 5 minced and moist consistency requirements. The nutrient properties of the dysphagia rice were improved through fortification with protein during the preparation process. The nutrient analysis was performed, and protein content was analysed using Dumas method. Speech therapist evaluation of the rice was conducted to further approve the texture and consistency that meet swallowing safety requirements.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Results: The outcomes this project were three types of protein fortified ready-to-eat dysphagia rice products namely white, pumpkin, and sweet potato rice which met the requirement of IDDSI Level 5 minced and moist consistency. The protein content for the rice products were 10.6g/100g for white rice, 11g/100g for pumpkin rice, and 10.2g/100g for sweet potato rice; as compared to the standard cooked white rice with only 2.8g/100g protein. The fortification has significantly increased the protein content of the rice products by approximately 260-290%.

Conclusions: These high protein dysphagia rice products will help to increase protein intake of not only the dysphagic individuals but elderly in general. With 50% of the Singapore elderly in need of an increased of protein intake, fortifying the rice staples with protein can be a cost effective and achievable method to help enhancing protein consumption.

Keywords: Dysphagia, Ready-to-eat, Rice, Nutrition

PAB(T4)-126
Association between nutritional status and chemotherapy interruption in outpatients with ovarian cancer

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Background and objectives: Discontinuation of cancer chemotherapy has been reported to worsen the prognosis of patients. However, few studies have examined the role of nutritional status before the start of treatment in chemotherapy interruption. The aim of this study was to determine the relationship between nutritional status at the start of chemotherapy and chemotherapy discontinuation in ovarian cancer including fallopian tube cancer and primary peritoneal cancer.

Methods: This was a retrospective case-control study. One hundred and forty-six patients with ovarian cancer, fallopian tube cancer, or primary peritoneal cancer were enrolled. They underwent postoperative chemotherapy as weekly Carboplatin and Paclitaxel therapy at the outpatient chemotherapy center of hospital X between April 2016 and March 2020. Patients were classified into two groups according to whether they had completed chemotherapy or not. Baseline characteristics and nutritional indicators were compared between the groups. Nutritional indicators included serum albumin level (ALB) and Prognostic Nutritional Index (PNI). In addition, the patients were divided into two groups according to ALB (cut off 3.1 g/dl) or PNI (cut off 50.1). The two groups were compared in terms of the number of times they received chemotherapy. Analysis was performed with JMP Pro 15 with statistical significance level of $p< 0.05$. This study was conducted with the approval of the Ethics Committee of Graduate School of Medicine, Chiba University. ALB and PNI were significantly higher and age was significantly lower in the completed group than in the incomplete group. The times of chemotherapy conducted was significantly lower in the low ALB group than in the non-low ALB group. Similarly, the times of chemotherapy conducted in the low-PNI group was significantly lower than that in the non-low-PNI group.

Results: ALB and PNI were significantly higher and age was significantly lower in the completed group than in the incomplete group. The times of chemotherapy conducted was significantly lower in the low ALB group than in the non-low ALB group. Similarly, the times of chemotherapy conducted in the low-PNI group was significantly lower than that in the non-low-PNI group.

Conclusions: ALB and PNI were associated with chemotherapy interruption and the times of chemotherapy which patients can be accepted. These results suggested that low nutritional status may play a role in chemotherapy discontinuation.

Keywords: Ovarian cancer, Nutritional status, Chemotherapy

PAB(T4)-127
Docosahexaenoic acid suppresses the generation of reactive oxygen species in endothelial cells: a role for retinoid X receptor RXR

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Background and objectives: Docosahexaenoic acid (DHA) is known to play an important role in several physiological functions. However, clinical evaluations of DHA for arteriosclerosis prevention have not been conducted conclusive and molecular mechanisms underlying DHA's effect remain unclear. To fill this research gap, we investigated molecular mechanisms for DHA's effect on endothelial cells using human umbilical vein endothelial cells (HUVEC).

Methods and results: High levels of reactive oxygen species (ROS) were generated following oxidative stress generated by irradiation of cells with light and the ROS thus produced diffused from the nucleus to the cytoplasm. We found that DHA (as low as 10 nM) strongly suppressed endothelial ROS generation, more so than eicosapentaenoic acid (EPA). We also noted that HUVEC showed a large variation in the reactivity of DHA depending on individual differences of donors. The effect of DHA was canceled by HX531, a retinoid X receptor (RXR)-selective antagonist. Additionally, bexarotene as an RXR-selective agonist similarly

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

suppressed endothelial ROS. We also found some DHA-insensitive HUVEC, from different donors, in which DHA does not suppress ROS generation even with high doses of DHA. However, when these cells were pretreated with LE 540 as a retinoid A receptor (RAR)-selective antagonist, then DHA suppressed ROS generation. When the DHA-insensitive HUVEC strains were cultured in a medium without retinol acetate, vitamin D_2 and cholesterol, the ROS inhibitory effect of DHA was restored. These factors are ligands of nuclear receptors that dimerize with RXR.

Conclusions: These results indicate that DHA suppresses the generation of endothelial ROS through interaction with RXR. Thus, the difference in reactivity to DHA may be determined by the amount of RXR available to bind to DHA.

Keywords: Docosahexaenoic acid (DHA), arteriosclerosis prevention, endothelial cells, reactive oxygen species (ROS), retinoid X receptor (RXR)

PAB(T4)-128
A case definition for thiamine responsive disorders: results from a prospective cohort study among infants and young children in Lao PDR

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Background and objectives: Thiamine deficiency disorders (TDD) describes the broad clinical conditions associated with thiamine deficiency, of which beriberi is best known. Due to the non-specific manifestations and the observation that infantile TDD can present in the context of acute infections, TDD may go unrecognized and untreated. Therefore, this study aimed to develop a case definition for thiamine responsive disorders (TRD) to determine among hospitalized children which clinical features and risk factors identify those who positively respond to therapeutic thiamine.

Methods: Children (aged 21 days – <18 months) were eligible for participation in this prospective cohort study if they presented to hospital with symptoms suggestive of TDD. Children were treated with parenteral thiamine (100mg daily) for ≧3 days alongside other treatments. Physical examinations and recovery assessment were conducted 0, 4, 8, 12, 24, 36, 48 and 72 hours after administration of the initial thiamine dose. Individual case reports were generated for each child and independently reviewed by three pediatricians who assigned a TRD score (TRD or non-TRD), that was used as the dependent variable in logistic regression models to identify predictors of TRD. Clinical prediction model performance was quantified by empirical area under the receiver operating characteristic curve (AUROC).

Results: In total, 449 children (mean±SD age 4.3±3.4 months; 60.8% male; 70.3% exclusively/predominantly breastfed) were enrolled. The majority of children presented with signs of cardiac and respiratory distress (70.8% difficulty breathing; 61.7% tachycardia; 45.2% tachypnea). Children were hospitalized for a median (Q1, Q3) of 3 (2,6) days. There was a high prevalence of TRD (60.8%). The AUROC (95% CI) was 0.82 (0.78, 0.86), indicating excellent discriminative capacity. Variables selected as most predictive of TRD were exclusive/predominant breastfeeding, hoarse voice/loss of voice, cyanosis, child not making eye contact and no diarrhea in the previous 2 weeks.

Conclusions: In this study population, there was a high prevalence of TRD, and the consensus recommendation would be that all children presenting with clinical signs/symptoms suggestive of TDD in this and similar settings with high risk of thiamine deficiency should be treated with thiamine. The usefulness of the case definition in other contexts requires further exploration.

Keywords: Beriberi, thiamine deficiency disorders, infants, children, Lao PDR

Conflict of Interest Disclosure: KHB, the spouse of SYH, previously worked for the Bill & Melinda Gates Foundation. All other authors declare no conflicts of interest.

Further Collaborators: Rebecca Stein-Wexler, University of California Davis, USA; Jay Yeh, University of California Davis, USA; Daniel J Tancredi, University of California Davis, USA; Michael A Schick, University of California Davis, USA; Christine N McBeth, University of California Davis, US; Kenneth H Brown, University of California Davis, USA

PAB(T4)-129
Can a new diet tracking app, myfood24 healthcare, support tier 3 weight management and gastroenterology surgery patients? A feasibility randomised controlled trial

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Background: Healthcare professionals regularly see patients requiring dietary support, however, they do not have all the tools needed to easily track food and nutrient intakes. Monitoring nutritional intake is of clinical value but few existing tools offer electronic dietary recording, instant nutritional analysis and a platform connecting healthcare teams with patients, providing timely, personalised support. This feasibility randomised controlled trial tests 'myfood24 Healthcare', a dietary assessment app and healthcare professional website in two clinical populations.

Methods: Two patient groups were included. Patients from a weight management programme in York and gastroenterology

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DOI: 10.1159/000530786

surgery outpatients, Leeds (UK). They were randomised into three groups: standard care, myfood24, or myfood24+diet optimisation (automated suggestions for dietary improvement). Participants were asked to record diet with the app at least four times over eight weeks. Healthcare professionals viewed patient dietary information linked to targets. Participants provided feedback on usability and acceptability.

Results: 21 weight management patients and 27 gastroenterology surgery patients were recruited and 16 randomised to each of 3 groups. Patient mean age was 51y and self-rated internet ability was only 'fair'. Compliance in app users (n 32) was good, with 25 (78%) using it at least once. Among users the mean (SD) days recorded was 14.0 (17.5). Mean daily energy intake for weight management patients was 1060 (SD 513) kcal; with energy from 29% fat, 52% CHO; 20% protein; and for gastroenterology patients 1209 (SD 675) kcal; with energy from 37% fat, 50% CHO; 13% protein. Feedback questionnaires were completed by 50%. Despite small numbers, some patients said symptoms had improved by using myfood24 and that it could help them manage their condition. The mean System Usability Score was 59 (95% CI, 48 to 70). Patient and healthcare professional feedback indicates that patients found the tool easy to use, but needed more user training at the start and improvement of some key app features such as the search function.

Conclusions: This feasibility study shows that myfood24 Healthcare app is acceptable for patients and healthcare professionals. These data have informed app refinements, which are now in place.

Keywords: Dietary assessment, diet app, healthcare professional, patient, weight management

Conflict of Interest Disclosure: Prof Cade is a Director of Dietary Assessment Ltd.

PAB(T4)-130
Amino Acid-Amadori Products Affect Protein Synthesis of Fibroblasts and Myotubes Derived from Chicken Embryos

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Background and objectives: Glycation is a non-enzymatic chemical reaction in which proteins and amino acids form Schiff base with reducing sugar like glucose. Schiff base undergoes Amadori rearrangement to form Amadori products (APs). A chicken is known to be one of hyperglycemic animals, and we found 7 types of amino acid-APs (Ile/LeuAP, LysAP, PheAP, TrpAP, TyrAP and ValAP) in the plasma of chickens. (Kita, K. et al., unpublished result). But physiological functions of amino acid-APs have not been clarified so far. In this study, therefore, the influence of amino acid-APs on protein synthesis of fibroblasts and myotubes derived from chicken embryos was examined.

Methods: Skin and breast muscle were excised from chicken embryos incubated for 19 days, and fibroblasts and myotubes were prepared, respectively. Amino acid-APs were synthesized from Ile, Leu, Lys, Phe, Trp, Tyr and Val, and added into culture medium. Final concentrations of amino acids-APs were 200 µM and 500 µM. ^{3} H-labeled amino acid, which is the substrate of amino acid-AP, was added into culture medium as a tracer for measuring protein synthesis. After overnight incubation, proteins were precipitated with TCA and the supernatant was collected. The radioactivity in protein and supernatant was measured with a liquid scintillation counter and used as indicators of protein synthesis and amino acid uptake into embryonic cells, respectively.

Results: In fibroblasts, amino acid-APs except for TrpAP, TyrAP and ValAP suppressed protein synthesis. Conversely, ValAP increased protein synthesis of fibroblasts. The decrease in protein synthesis by amino acid-APs was significantly correlated to the decline of amino acid uptake into intracellular fluid of fibroblasts. In myotubes, only LysAP and TyAP significantly suppressed protein synthesis. Interestingly, amino acid uptake into intracellular fluid of myotubes was increased by adding amino acid-APs into culture medium.

Conclusions: It was concluded that some of amino acid-APs would decrease protein synthesis of fibroblasts accompanied with a decline of amino acid uptake. On the other hand, ValAP may have different function to increase protein synthesis of fibroblasts. Some of amino acid-APs also decrease protein synthesis of myotube but not accompanied with a decrease of amino acid uptake.

Keywords: Amino acids, glycation, chicken, fibroblasts, protein synthesis

PAB(T4)-131
Plant foods consumption and its association with cardiovascular disease risk profile in South Africans at risk of diabetes

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Background and objectives: Plant foods differ in their nutrient content and can be classified as healthy (i.e., fruits and vegetables) or less healthy (i.e., sugar-sweetened beverages). Nutrient-rich plant foods are healthier and contain bioactive compounds such as polyphenols with antioxidant properties that may protect against cardiovascular disease (CVD). We assessed the distribution of healthy plant foods and its association with CVD risk factors in South African adults at high risk of diabetes.

Methods: This cross-sectional study utilized baseline screening data from the South African Diabetes Prevention Programme (SA-DPP). Participants identified as being at high risk of diabetes underwent data collection including a non-quantified 24-hour dietary recall, physical examination, and biochemical analysis. Group comparisons used appropriate statistical tests to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

explore differences in the distribution and associations of common CVD risk factors by plant foods consumption.

Results: Among 693 participants (81% females), the mean age was 51 years (SD=8.95). The prevalence of obesity was higher in consumers of cereals than in non-consumers (86% vs. 14%, p=0.018). Compared with non-consumers, consumers of maize had lower fasting insulin (7.8 vs. 9.6 mIU/L, p<0.001), lower LDL-cholesterol (3.0 vs. 3.2 mmol/L, p=0.011), lower triglycerides (1.2 vs. 1.3 mmol/L, p=0.023) and lower fibrinogen (3.6 vs. 3.8 g/L, p=0.005) levels; consumers of yellow coloured vitamin A rich vegetables and tubers had lower systolic blood pressure (125 vs. 128 mmHg, p=0.030) and lower triglycerides (1.2 vs. 1.3 mmol/L, p=0.028), while consumers of vitamin A rich fruits had lower fasting plasma glucose (5.0 vs. 5.4 mmol/L, p=0.001). Regression analysis revealed a negative association between body mass index >30 kg/m^2 and white roots and tubers consumption (adjusted odds ratio: 0.64, p=0.048).

Conclusions: Significant differences were apparent in the distribution of some CVD risk factors between consumers and non-consumers of certain plant foods. The association of healthy plant foods consumption and CVD risk reduction needs further investigations in this setting.

Keywords: Plant foods, Cardiovascular disease risk factors, Type 2 diabetes

Conflict of Interest Disclosure: None.

Further Collaborators: None.

PAB(T4)-132
Thiamin insufficiency as a risk for heart failure

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Background and Objectives: Vitamin deficiency causes such diseases as rickets (vitamin D) and beriberi (thiamin; vitamin B1), but even vitamin insufficiency, milder than deficiency, increases the disease risk. Most studies on vitamin insufficiency have been on vitamin D, and little attention has been paid on thiamin. Our hypothesis is that insufficiency of thiamin, indispensable in energy metabolism, would affect cardiac function, and be a risk for heart failure.

Study 1 Subjects and Methods: Institutionalized elderly were evaluated for their whole blood (WB) thiamin concentration and plasma brain natriuretic peptide (BNP) level, a sensitive marker for heart failure. Information was also obtained on anthropometry and prescribed drugs.

Results: WB thiamin concentration has exhibited a significant negative correlation with plasma BNP level. Multiple regression analysis has revealed that WB thiamin concentration is a significant negative contributor to plasma BNP level corrected by age, BMI, and eGFR. In two-thirds of the subjects, plasma BNP level was higher than 40 pg/mL, suggesting the possibility of heart failure. Decreased WB thiamin concentration was a significant contributor to plasma BNP level higher than 40pg/mL by the logistic regression analysis. In subjects with diuretics use, WB thiamin concentration was significantly lower than those without it.

Study 2 Subjects and Methods: Patients visiting cardiology clinic were evaluated for WB thiamin and plasma BNP level. Information was also obtained on anthropometry, prescribed drugs, and dietary intake using BDHQ.

Results: Significant negative correlation was observed between WB thiamin concentration and plasma BNP level in thiamin-deficiency/insufficiency group, but not sufficiency group. Multiple regression analysis has revealed that WB thiamin concentration and eGFR significantly and negatively contributed to plasma BNP level corrected by age and gender in thiamin-deficient/insufficient group. Patients with loop diuretics use had lower WB thiamin concentration and higher BNP level than those without it.

Conclusions: In both institutionalized elderly and patients visiting the cardiology clinic, thiamin insufficiency was suggested to be a modifiable risk for heart failure. Considering that elderly heart failure is markedly increasing in number, our results would be of possible clinical and societal significance.

Keywords: Thiamin, heart failure, vitamin insufficiency

PAB(T4)-133
Adherence to the World Cancer Research Fund/American Institute for Cancer Research Cancer Prevention Recommendations and risk of overall, breast, prostate, colorectal and lung cancer in the UK Biobank

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Background and objectives: Approximately 40% of cancers in the UK are attributable to modifiable, lifestyle risk factors such as smoking, overweight and obesity and low dietary fibre intake. The World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR) published ten lifestyle-based Cancer Prevention Recommendations with the aim of reducing the risk of cancer and other non-communicable diseases worldwide. We investigated associations between adherence to these Cancer Prevention Recommendations and the risk of overall cancer and of the top four cancers (breast, prostate, colorectal and lung) in the UK.

Methods: We used data from 139,491 UK Biobank participants, mean age 55.9 years (range 40–72) recruited between 2006 and 2010 and without cancer at baseline. Scores for adherence to the Cancer Prevention Recommendations were calculated from dietary (food frequency questionnaire and 24-hour recall), physical activity (International Physical Activity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Questionnaire) and body composition (body mass index and waist circumference) data using the standardised scoring system by Shams-White and colleagues. Scores ranged from 0 (lower adherence, unhealthier lifestyle) to 7 (higher adherence, healthier lifestyle) points. Incident invasive cancer cases were identified through linked population-based cancer registries. Cox proportional hazard models were used to investigate associations, adjusting for age, sex, ethnicity, Townsend deprivation index and smoking status.

Results: The mean adherence score was 3.57 (SD 1.04) points. Over a median follow-up time of 7.9 years (IQR 7.3 – 8.6), there were 10,756 incident cancers. We observed a 7% reduction in overall cancer risk per 1-point increment in score (HR 0.93; 95%CI 0.91-0.94, P<0.001). There were significant associations between total score and risk of breast (HR 0.90; 95%CI 0.86-0.94, P<0.001) and colorectal (HR 0.89; 95%CI 0.84-0.94, P<0.001) cancer, but not for lung (HR 0.94; 95%CI 0.87-1.02, P=0.126) or prostate (HR 1.00; 95%CI 0.97-1.04, P=0.888) cancers.

Conclusions: This is the first study to investigate associations between adherence to the WCRF/AICR Cancer Prevention Recommendations and the risk of overall, breast, prostate, colorectal and lung cancers in a UK cohort. Higher adherence scores were associated with reduced risk of overall, breast and colorectal cancer, supporting compliance to the WCRF/AICR Cancer Recommendations for cancer prevention.

Keywords: Cancer Prevention Recommendations, lifestyle, cancer risk

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

PAB(T4)-134
Vitamins C and E supplementation alleviate oxidative stress and lipid peroxidation in pediatric patients with acute lymphoblastic leukemia receiving chemotherapy

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Background and objectives: Oxidative stress is associated with cancers via lipid peroxidation and DNA damage. Antioxidants play roles in protection against cancers. The most common cancer in childhood is acute lymphoblastic leukemia (ALL). Many of the components given to treat leukemia are associated with free radical production. This study was conducted to evaluate the effect of vitamin C (VC) and E (VE) supplementation on the oxidative stress and antioxidant status in pediatric patients with ALL during chemotherapy.

Methods: Twenty-four pediatric patients diagnosed with ALL were recruited and divided into 2 groups using a randomized selection as the intervention group and the placebo group during chemotherapy for 6 months. The intervention group received VC (500 mg/d) and VE (200 IU/d) supplementation in addition to chemotherapy. Levels of erythrocyte reduced glutathione (GSH), plasma VC, VE:total cholesterol ratio (VE:TC ratio) were evaluated. The activities of erythrocyte superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), malondialdehyde (MDA, a marker of lipid peroxidation), and 8-hydroxy-2'-deoxyguanosine (8-OHdG, a product of DNA damage) were assessed.

Results: At baseline, the levels of antioxidant enzymes, VC, VE, MDA, and 8-OH-dG of the intervention and placebo groups were not significantly different (p>0.05). At 6 months of chemotherapy, the mean levels of VC and VE:TC ratio in the intervention group were statistically higher than those in the placebo group (8.08±6.88 vs. 3.43±3.50 µg/dL, p=0.049 and 9.13±4.05 vs. 4.76±1.89 mg/g, p=0.004, respectively). The intervention group had the mean levels of SOD, GPx lower than the placebo group; however, the mean levels of CAT in the intervention group was higher than the placebo group without a significance. The intervention group had a significantly lower MDA levels than the placebo group (1.10±1.08 vs. 3.63±3.52 µM, p=0.027). The 8-OHdG levels were not significantly different between 2 groups.

Conclusions: Patients with ALL receiving chemotherapy in conjunction with VC and VE supplements had lower oxidative stress and lipid peroxidation.

Keywords: Acute lymphoblastic leukemia, Antoxidant, Lipid peroxidation, Oxidative stress, Vitamin C and Vitamin E

PAB(T4)-135
The Association between Rice Intake and Chronic Kidney Disease: the Toon Health Study

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Background and objectives: Almost one in eight Japanese adults have chronic kidney disease (CKD). Although rice intake may increase the risk of diabetes which is one of the major risk factors for CKD, the association between rice intake and CKD remained unknown. The objective of our study was to examine the association between rice intake and CKD in Japanese adults.

Methods: This cross-sectional study included 1665 Japanese men and women aged 30-84 years who participated in the Toon Health Study. We calculated estimated glomerular filtration rate (eGFR), and defined CKD as eGFR <60 mL/min/1.73 m^2. Furthermore, albuminuria was defined as urinary albumin in >=30mg/L. Rice intake was assessed by food frequency questionnaire, and adjusted for energy intake by residual method. The participants were divided into sex-specific quartiles according to rice intake. We calculated the multivariable-adjusted odds ratio (OR) and 95% confidence intervals (95%CIs)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of CKD and albuminuria according to the quartiles of rice intake using the logistic regression model.

Results: We found no significant association between rice intake and CKD. The multivariable-adjusted OR of CKD was 0.87 (95%CI: 0.60-1.25, p for trend =0.44) for the highest quartile of rice intake compared with the lowest quartile. However, we found that higher rice intake tended to be associated with lower odds of albuminuria; the OR of albuminuria was 0.59 (95%CI 0.32-1.08, p for trend =0.09). After stratification by current drinking status, the OR of CKD for the highest quartile was 0.88 (95%CI 0.53-1.47, p for trend =0.63) and albuminuria was 1.00 (95%CI 0.41-2.49, p for trend =0.99) in the non-drinking group; but in the current drinking group, the OR of CKD for highest quartile was 0.82 (95%CI 0.48-1.39, p for trend =0.45) and albuminuria was 0.37 (95%CI 0.15-0.91, p for trend =0.03). This association in the current drinking group remained significant after further adjustment for ethanol intake.

Conclusion: Higher rice intake may be associated with a lower presence of albuminuria for individuals with a drinking habit (or who consumes alcohol).

Keywords: Rice intake, Chronic kidney disease, Albuminuria

PAB(T4)-136
The association between dietary macronutrients consumption and the prevalence of metabolic syndrome among male South African taxi drivers

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Background and objectives: Diet is a major modifiable lifestyle factor that can influence metabolic syndrome and its components. To examine the association of dietary carbohydrates, protein, and fat (including fatty acid subtypes) with the metabolic syndrome and its components, in a cross-sectional study of 237 male taxi drivers.

Methods: The associations between macronutrients (as determined by a 24-hour dietary recall) and the metabolic syndrome (defined by International Diabetes Federation (IDF)) were investigated using multivariate nutrient density substitution models. These models depict the effects of substituting one macronutrient for another while maintaining total energy intake constant.

Results: Increases in carbohydrates offset by isoenergetic decreases in either protein or fat were associated with a little increase in the prevalence of the metabolic syndrome (OR 1.001 (95 % CI 0.997-1.005); OR 1.001 (95 % CI 0.997-1.005)). Increased intake of dietary fat at the expense of dietary protein was also associated with little increased prevalence of the metabolic syndrome (OR 1.005 (95 % CI 0.973-1.038), per 5 % energy intake). Favouring fats over protein was associated with little odds of abnormal obesity, whereas favouring either carbohydrates or fats over proteins was associated with lower odds of the blood pressure component of the metabolic syndrome. There was no statistical difference between the relative proportions of dietary macronutrients or fatty acids and the presence of the metabolic syndrome.

Conclusions: A diet high in carbohydrates, either in low fat or protein, is associated with a slightly increased in the prevalence of metabolic syndrome. Therefore, the relative distribution of macronutrients may be related to metabolic syndrome.

Keywords: Metabolic syndrome, macronutrients intake, substitution model, taxi drivers, South African man

Conflict of Interest Disclosure: No conflict of interest

PAB(T4)-137
Effects of n-3 PUFAs on the generation and characteristics of EVs generated in vitro from washed platelets

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Background and Objective: Platelet-derived EVs (PDEVs) comprise the most abundant EV population in the circulation, at least in healthy individuals, and may contribute to the development and progression of cardiovascular diseases (CVDs) through their procoagulant activities, thus, serve as emerging biomarkers for cardiovascular health. PDEVs can potentially be modified by dietary fatty acids since they carry bioactive lipid mediators and their cell membrane fatty acid composition can be modified by dietary fatty acids, including n-3 polyunsaturated fatty acids (PUFAs), which are abundant in oily fish and fish oil and reported to reduce risk of cardiovascular diseases. This study investigated whether supplementation with n-3 PUFAs alters the generation and characteristics of PDEVs.

Methods: Forty subjects with moderate risk of CVDs were supplemented with either 1.8 g/d n-3 PUFA or control (high-oleic safflower oil) for a 12-week period. To isolate PDEVs in vitro, washed platelets, obtained before and after each intervention period, were incubated in the presence or absence of the stimulant, 30 µM Thrombin Receptor Activator Peptide-6 (TRAP-6), for 2h at 37°C. Platelets were then removed by centrifugation and EVs were pelleted and washed. The generation and characteristics of PDEVs were assessed by Nanoparticle Tracking Analysis (NTA) and flow cytometry. Total fatty acid composition of PDEVs was evaluated by gas chromatography.

Results: There was no effect of the intervention on the size and numbers of PDEVs generated in vitro, regardless of whether they were derived from unstimulated or stimulated platelets. Supplementation with fish oil significantly increased the content of EPA and total n-3 PUFA of EVs generated in vitro by either unstimulated or stimulated platelets, while decreasing that of arachidonic acid, compared with the control group. Fish oil significantly decreased the expression of PS by only EVs generated from unstimulated platelets.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: N-3 PUFA supplementation had no effect on the number or size of EVs generated in vitro from stimulated or unstimulated platelets, but altered their fatty acid composition and, in the case of EVs derived from unstimulated platelets, decreased their surface expression of PS.

Keywords: Cardiovascular disease, n-3 polyunsaturated fatty acids, fish oil, platelets, extracellular vesicles

PAB(T4)-138
The effect of fructose on impaired neutrophil differentiation caused by mitochondrial dysfunction

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Background and objectives: Mitochondrial dysfunction cause mitochondrial diseases with variety symptoms in organs and cells. Mitochondria has been reported to regulate cell differentiations via its functions such as ATP production and ROS generation. We have previously reported that disruption of adenylate kinase 2 (AK2), a mitochondrial energy metabolic enzyme, leads to mitochondrial dysfunction, including decreased ATP production, elevated oxidative stress, and impairment of ATP-dependent systems. And AK2 deficiency causes reticular dysgenesis, a severe combined immunodeficiency with neutropenia and sensory deafness. In this study, we tried to improve the impairment of neutrophil differentiation by enhancing glycolytic ATP production with fructose using AK2 deficiency model cells.

Methods: Human promyelocytic leukemia cell line HL-60 was differentiated into neutrophil with all-trans retinoic acid (ATRA). AK2 hetero-knockout HL-60 was generated using CRISPR/Cas9 genome-editing system. Unfortunately, we could not get complete KO cells. Fructose was added during induction of differentiation by ATRA, and we evaluated the effects of fructose treatment on the neutrophil differentiation rate and intracellular ATP amount in wild type (WT) and AK2 hetero-knockout HL-60.

Results: We confirmed that AK2 activity is decreased by about half in AK2 hetero-knockout HL-60. To evaluate neutrophil differentiation rate, we checked protein expression of CD11b, a differentiation marker expressed from the early stage to the mature stage of neutrophil differentiation, in WT cells and AK2 hetero-KO cells on day 4. CD11b was not changed between WT HL-60 and hetero-knockout HL-60. Therefore, we evaluated the proportion of differentiation stages morphologically. Undifferentiated cells were more and matured neutrophils were less in AK2 hetero-knockout than those in WT significantly in the absence of fructose. Also, fructose treatment restored the percentage of mature neutrophils in AK2 hetero-KO HL-60. Then, ATP production during neutrophil differentiation was measured, and no significant difference was observed between WT and AK2 hetero-knockout HL-60 with and without fructose treatment.

Conclusions: From these results, fructose may recover neutrophil differentiation not by glycolytic ATP production under condition of impaired mitochondrial ATP production.

Keywords: Neutrophil differentiation, Fructose, Mitochondria, ATP

PAB(T4)-140
Degradation of Lys-Amadori Product in the Extract Derived from Kidney of Chickens

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Background and objectives: Non-enzymatic chemical reaction of amino acids with reducing sugars such as glucose generates amino acid-Amadori products (APs), which can be intermediates of advanced glycation end products (AGEs). We found seven amino acid-APs in the plasma of chickens (Kita, K. et al., unpublished results), which are known to be hyperglycemic animals. Fructosamine-3-kinase (FN3K) is an enzyme identified in human erythrocytes can degrade APs using ATP. In our previous study, gene expression of FN3K was observed in several tissues (brain, heart, liver, kidney and muscle) of chickens. But it has not been clarified whether tissue FN3K can degrade amino acid-APs or not. In this study, therefore, we examined the degradation of Lys-AP by the extract derived from kidney of chickens.

Methods: Animals - Newly hatched male chickens (single comb White Leghorn) were purchased from a local hatchery and fed with a commercial starter feed for 20 days. Sample – Under anesthesia, blood was collected by heart puncture, and then kidney was removed and cut into 300 mg pieces. Tissue Extract – Kidney pieces was homogenized with 500 µl DPBS. Then, homogenate was centrifuged at 4 ℃, 8000 x g for 20 minutes. The supernatant was collected and passed through a 0.22 µm sterile filter. Degradation Experiment – The 3 ml of filtrated supernatant was transferred into a 15 ml centrifuge tube and added Lys-AP with final concentration of 300 µM. Samples were incubated at 37 ℃ overnight in the presence or absence of 1-deoxy-1-morpholinofructose (DMF), which is an inhibitor of FN3K. After incubation, samples were defatted and deproteinized, and Lys-AP concentration was measured by LC/MS.

Results: After incubating Lys-AP with extract derived from chicken kidney, the concentration of Lys-AP in the presence of DMF was significantly higher than that in absence of DMF. The lower concentration of Lys-AP in the absence of DMF would be resulted by the degradation of Lys-AP by FN3K existed in the extract derived from kidney.

Conclusion: It was concluded that FN3K exists in the kidney would degrade Lys-AP generated in vivo.

Keywords: Amadori products, Amino acid, chicken, FN3K, Glycation

PAB(T4)-141
A national survey of Japanese medical facilities to consider promoting the implementation of nutritional diagnosis

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Background and objects: Almost no reports exist regarding the implementation of Nutrition Diagnosis (ND) at hospitals and its effectiveness in Japan. This study focuses on ND among nutrition care processes and uses a survey of hospitals in Japan to investigate the awareness and implementation of ND, its benefits, and reasons for non-implementation. It also considers how to support for the wider implementation of ND.

Methods: The objects were supervisors of registered dietitians and dietitians at the 2,482 hospitals. The requests to cooperate with the surveys were mailed to the objects at the targeted facilities at the beginning of September 2021 and respondents were asked to fill them out and return them by the end of the month. IBM® SPSS® Statistics 26 (IBM Japan, Ltd.) was used for the statistical analysis. Chi-square tests were used to determine significance, with a significance of $p<0.05$.

Results: Responses were received from 732 hospitals (29.5%). Of them, 13.8% were implementing ND. Regarding employment of registered dietitians at their facilities, 10.8% had one or fewer and 31.8% had 6 or more. The benefits that facilities realized most often from implementing ND were, “ND make patients' nutrition issues clear,” at 83.2%. The most frequent reason for not implementing ND was “It is hard to have a common understanding among the staff,” at 40.1%, followed by “We did not have the opportunity to learn it,” at 39.0%. For the desired support for implementation, the most frequent response was “Opportunity to learn ND at a training session,” at 75.8%, followed by “An easy-to-understand ND manual,” at 73.9%. “An easy-to-understand ND manual” was 69.1% in the group with six or more registered dietitians belonging to the hospital and 84.5% in the group with one or fewer. It should be noted that the group of with 1 or fewer was significantly more common than the group of 6 or more ($p=0.008$).

Conclusions: The percentage of hospitals implementing ND is 13.8%. It was suggested that support considering the difference in the number of registered dietitians may be effective in disseminating nutritional diagnosis.

Keywords: Nutrition Diagnosis, Nutrition care process, Registered dietitian

Further Collaborators: Kisumi Oda and Sae Fujii also worked on data entry.

PAB(T4)-142
Challenges of Dietary Management of Diabetes Mellitus in the African Setting

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Background and Objective: The incidence and prevalence of Type 2 Diabetes Mellitus continues to rise rapidly, and is of great public health concern. About 500 million people are living with the condition globally, and this poses both disease and economic burdens. The condition is not usually curable, and has to be managed in various ways. Proper dietary management is of great importance in delaying and avoiding the onset of complications associated with the conditions. The complications increase the risk of morbidity and mortality. The main objective of this study was to evaluate the challenges encountered in dietary management of Diabetes Mellitus in the African Setting.

Methods: The method employed in the study is a review of literature using search engines, including Google Scholar.

Results: Most of the African diets include starchy staples that are consumed with an accompaniment of vegetable or meat stews. The starchy staples are predominantly cereals- maize, sorghum millets and rice. Other starchy staples include cassava, yams, and sweet potatoes. Among the key challenges is that these starchy foods are converted to glucose in the body, contributing to high blood glucose levels. There are many varieties of each of these staple foods. For instance there are over 30 varieties of sorghum, and over 20 varieties of finger millets. These varieties differ significantly in their nutritional and anti-nutrient composition, and also in their digestibility. The same applies, to a less extent, to cassava and sweet potatoes, and the other staples. There is little information on the glycemic index and glycemic load of these foods which will differ among these varieties. Different food preparation methods will also affect the glycemic index. Yet the dietary recommendations provided for Diabetes Mellitus do not take into account these differences.

Conclusion: The many varieties of the staple foods in African diets that differ in nutrition composition, digestibility and glycemic index pose a big challenge in providing guidelines for dietary management of Diabetes Mellitus in the African setting.

Keywords: Diabetes Mellitus, Dietary management, Staple foods, Varieties, Glycemic index

Conflict of Interest Disclosure: The authors declare that there is no conflict of interest in presenting this paper at the IUNS Congress in Tokyo.

Further Collaborators: No other collaborators.

PAB(T4)-143
Obesity is associated with greater prevalence of perimenopausal symptoms: findings from the ZOE Health study in 25,570 participants

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Background and objectives: The menopause or perimenopause, is a challenging time for midlife females that is often marked by multiple somatic, psychological, and urogenital symptoms caused by changes in key hormone levels. Here we investigate the impact of body weight on menopausal symptoms in 25,570 perimenopausal females from the smartphone-based ZOE Health App.

Methods: Self-reported menopausal symptoms (vaginal dryness, vasomotor (hot flashes, chills, night sweats), sleep disturbances, mood, thinning hair or dry skin and loss of breast fullness) and baseline characteristics (age and body mass index (BMI)) were assessed in self-reported perimenopausal females (n=25,570). Females taking menopausal hormone therapy (MHT) were excluded from analysis. The relationship between BMI groups (healthy 20-25 kg/m^2 and obese 30-35 kg/m^2) and the prevalence of menopausal symptoms was investigated using binomial logistic regression.

Results: The most commonly reported menopausal symptoms included sleep problems (68% of women), night sweats (60%), mood changes (60%) and hot flashes (59%). In this perimenopausal cohort, 57% of women had an unhealthy BMI (overweight 25-30 kg/m^2; 30%, obese; 16% and morbidly obese >35 kg/m^2; 11%) while 43% had a healthy BMI. The number of symptoms experienced was associated with BMI (r; 0.08, p<0.001), and higher in obese versus normal weight females (4.0 *vs* 3.7 symptoms). The top symptom for both healthy weight and obese women was sleep problems (66% and 71%). Logistic regression was performed to ascertain the effects of BMI on the likelihood that a woman experienced menopausal symptoms. Chills, thinning of hair or dry skin, hot flashes, mood changes, and sleep problems are (RR with 95% CI) 38% [28-49], 23% [18-29], 17% [14-20], 8% [5-11] and 7% [4-9] more likely, respectively, in obese women compared to healthy weight women.

Conclusion: This study shows that obese women are more likely to experience menopausal symptoms. Higher BMI and lower oestradiol levels can lead to insulin resistance and increased risk of type 2 diabetes. Future studies are needed to understand how oestradiol can reduce weight gain, insulin resistance and menopausal symptoms experienced post-menopause.

Keywords: Perimenopause, Obesity, Symptoms

Funding: ZOE Ltd

Conflict of Interest Disclosure: TDS, JW and GH are co-founders of ZOE Ltd (ZOE). TDS and SEB are consultants to ZOE. AM, SP, CH, JC and SS are employed by ZOE. Other authors have no conflict of interest to declare.

PAB(T4)-144
The protective effect of glycyrrhizin, a natural sweetener, on the incidence of early puberty

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Background and objectives: Precocious puberty (PP) is characterized by the early development of secondary sexual characteristics, which may lead to many adverse outcomes. Gonadotropin-releasing hormone analog (GnRHa) is currently the first-line treatment for PP. However, it is a costly and invasive medication that may create an unpleasant experience for patients. Therefore, in this animal model, we aimed to investigate the protective effect of oral glycyrrhizin (as monosodium salt - MAG), a commonly used natural sweetener, against early puberty in female rats.

Methods: We divided 25 young female Sprague-Dawley rats into Control, Danazol, Low MAG (100 μg/kg/day), and High MAG (200 μg/kg/day) groups. A PP model was established by injection of danazol on postnatal day (PND) 5, and the MAG had been administered daily since PND 13. The time of vaginal opening (primary outcome), the day of setup of regular cycle, and the day of establishment of 3 regular cycles (secondary outcomes) were observed. Blood was taken to confirm the safety of MAG. We also collected their stool samples for microbiome and short-chain fatty acid (SCFA) analyses to explore the mechanistic pathways.

Results: High MAG significantly delayed vaginal opening day compared to the Danazol group (27.86±5.31 vs. 23.00±0.00, p=0.029). We observed similar effects for two secondary outcomes (p=0.008 and <0.001, respectively). Meanwhile, Low MAG only delayed the day of establishment of 3 regular cycles (44.29±3.95 vs. 38.00±0.82, <0.001). There is no significant difference in body weight during puberty, body weight and weight of reproductive organs on sacrifice day. Routine laboratory tests were comparable among groups. Regarding gut microbiome, High MAG rats showed a significantly different beta-diversity compared to the Danazol group. We identified enriched taxa in the High MAG group, including *Ruminococcaceae UCG-008*, *Lachnoclostridium*, and *Muribaculaceae*, and in the Low MAG group, including *Ruminococcus gnavus* and *Clostridium innocuum*. They tended to be negatively correlated with SCFA levels, especially butyric acid, which is often linked with early puberty.

Conclusions: MAG protected rats against PP in a dose-response manner. MAG exerted its benefits by reducing butyrate-producing gut bacteria. MAG may serve as a complementary therapy to GnRHa in treating PP.

Keywords: Glycyrrhizin, precoccious puberty, gut microbiome, short-chain fatty acid

Conflict of Interest Disclosure: The authors have no conflicts of interest relevant to this article to disclose.

PAB(T4)-145
Body fat is associated with higher mortality in patients with hemodialysis

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Background and objectives: Patients with hemodialysis (HD) have higher premature mortality. Higher BMI is related to lower mortality in this population. However, body weight is poor obesity indicator. Therefore, this study tried to find out the association between body fat and mortality in HD patients.

Methods: This was a multiple-center prospective study. Maintenance HD patients were recruited in this study. All subjects were aged 20 years and above, who had received three hemodialysis treatment per week for at least 3 months, and were equilibrated Kt/V more than or equal to 1.2. Patients excluded from the study were those diagnosed with one or more medical conditions including cancer or malignancy or hepatic failure. All data and information were collected at baseline, then the information of all-causes mortality was collected at followed up period. Body fat was assessed by the same bioelectrical impedance analysis device using multiple operating frequencies.

Results: 318 patients with HD treatment were recruited in this study with completed information. During the median follow-up of 1.4 years, 59 patients were dead. Comparing with dry body weight in normal range, both overweight and obesity did not increase mortality. Besides, there was no association between body mass index (BMI) and mortality. Higher percentage of body fat was significantly related to increased mortality after adjust for age, sex, diabetes, and hemodialysis duration (odds ratio was 1.05, 95% confidence limits was 1.01-1.09, p=0.01). Both C-reactive protein (CRP) and Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) did not adjust the association between body fat and mortality.

Conclusions: Among these patients with HD treatment, there is a positive association between body fat and mortality. Higher CRP and HOMA-IR may not be the reason. More researches with high quality are needed.

Keywords: Hemodialysis, Body fat, Mortality

PAB(T4)-146
Evidence for the Protein Leverage Hypothesis in Young Children Prone to Obesity: A Cohort Analysis From the 'Healthy Start' Study

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Background and objectives: The protein leverage hypothesis (PLH) proposes that the rise in obesity has been caused partly by a shift towards diets with reduced protein energy/non-protein energy ratios relative to the set point for protein intake, which is strictly regulated in people. Evidence for the PLH comes from studies in animals and adult humans, while studies in children are few. Thus, the aim is to test the PLH in young children prone to obesity.

Materials and methods: Data were from the 'Healthy Start' intervention study of young children prone to obesity. Dietary information was measured by a 4-day dietary record. Body mass index (BMI) *z* scores, fat mass percentage (FM%), waist-height (WHtR) and hip-height ratio (HHtR) were measured by trained health professionals. The strength of leverage (L coefficient) for protein was tested by fitting the power function to the relationship between energy intake and protein (%). Multiple linear regression analyses were carried out for the association between total energy intake and anthropometrics. The energy composition of dietary macronutrients (%) with total energy intake and each anthropometric was presented using the Nutritional Geometry, visualized through response surfaces, and analyzed through mixture models.

Results: A total of 553 individuals aged 2-6 years were included and followed for 1.3 years. At baseline, total energy intake (Mean [SD]) was 4.8 (1.0) MJ/day, energy proportion from protein (%) was 15.7 (2.3) %, carbohydrate (%) 54.8 (4.7) %, and fat (%) 29.5 (4.5) %. At baseline, there was an inverse relationship between dietary protein (%) and total energy intake, which followed a power function (L coefficient -0.19; P< 0.01). Higher total energy intake (per unit [MJ/day]) was associated with an increase in BMI z scores (b [CI 95%]: 0.04 [0.01, 0.07]), and FM% (0.93 [0.09, 1.77]) over 1.3 years. Notably, a diet lower in protein (%) at baseline was associated with a subsequent increase in BMI *z* scores, WHtR, and HHtR after 1.3-year follow-up, in support of the PLH.

Conclusion: Evidence for the PLH was found in young children prone to obesity, showing that children with dietary protein diluted by carbohydrate or fat had higher energy intake, later weight gain and adiposity risk over 1.3 years.

Keywords: Dietary protein, total energy intake, obesity, children

Conflict of Interest Disclosure: No Conflict of Interest

Further Collaborators: No

PAB(T4)-147
Impact of early enteral nutrition in patients with COVID 19 under invasive ventilation

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Background and objectives: Nutritional support is particularly important on the patient with COVID 19 under mechanical ventilation as it strengthens the immune system. This research seeks to relate the implementation of enteral nutrition with the reduction of invasive mechanical ventilation time and mortality rate.

Methodology: A study was carried out at the Guanajuato General Hospital, 89 patients (49 women and 41 men with COVID 19 pneumonia under mechanical ventilation were included. The population was divided into three groups. Those who received early enteral nutrition (<36 hours), late enteral nutrition (>36 hours) and those who did not receive nutrition. Acute phase reactants (leukocytosis, CPR, DHL, Lymphocytes), length of hospital stay and days of ventilation were evaluated using Student`s T analysis, mortality in each of the groups using X^2 and Odds Ratio. Survival was calculated from Kaplan Meier with long rank test.

Results: Early enteral nutrition (NTE) was administered in 19 patients, 17 patients received late enteral nutrition (NTA) and 53 patients did not receive enteral nutrition (NN). The days of mechanical ventilation with NTE a mean of 11.11 $\pm$ 12.351 was established, for patients with NTA with a mean of 16.29 $\pm$ 7.523 and for those NN 4.64 $\pm$ 3.552. And OR of 3.22 was obtained for death as an outcome in the group of patients who did not receive enteral nutrition and an OR of 0.15 for the group that received early enteral nutrition. OR of 5.75 for death as an outcome for patients who received delayed nutrition. The was no significant difference in the gender variable regarding the decrease in acute phase reactants with $p<0.05$ who received NTE was 18.73 and for the group of NN patients ii was 8.41

Conclusion: The start of early enteral nutrition was associated with a lower risk of mortality and an increase in days of interhospital stay is explained in the study as greater survival.

Keywords: Enteral diet, mechanical ventilation

Conflict of Interest Disclosure: ANY

Further Collaborators: ANY

PAB(T4)-148
The effects of upper- and lower-body exercise on postprandial triglycerides in healthy young men

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Background and objectives: Over one-third of Japanese adults aged between 20 and 29 consumed daily meals containing over 30% of energy as fat. Elevated non-fasting triglycerides (TG) is associated with an increased incidence of cardiovascular disease. Ample evidence supports the notion that acute aerobic exercise, weight-bearing exercise in particular (i.e., walking and running), mitigates the elevation of TG concentrations after a meal. Arm cranking and cycling exercises are characterised as non-weight-bearing exercises and are often recommended as replacement strategies for those who have any condition/preference with limited ability to run. Nevertheless, it remains unclear whether the similar reduction in postprandial TG could be obtained as demonstrated by weight-bearing exercise if healthy individuals perform arm cranking or cycling exercises. Furthermore, it is not clear whether a similar benefit, if any, on a reduction in postprandial TG between these non-weight-bearing exercises. Therefore, this study aimed to examine the effect of an acute bout of upper- and lower-body exercise on postprandial TG concentrations in young men.

Methods: Fifteen healthy young men (aged 22±2 years, mean±standard deviations) underwent three, 2-day laboratory-based trials in random order: control, upper-body exercise and lower-body exercise. On day 1, participants rested from 0900 to 1600 and performed upper-body exercise or lower-body exercise at a workload predicted to elicit 70% of maximum/peak oxygen uptake for pre-determined exercise duration which was designed to induce a net energy expenditure of 1255 kJ (300 kcal), or rested between 1600 and 1700. On day 2 of each trial, participants rested and consumed standardised test meals for breakfast (1000) and lunch (1300). Venous blood samples were collected in the fasted state (0900), at 1000, 1100, 1300, 1500 and 1700 on day 2.

Results: Postprandial TG concentrations were higher throughout day 2 in the control trial (1.62±0.74 mmol/L) than the lower-body exercise (1.34±0.50 mmol/L) and upper-body exercise (1.37±0.62 mmol/L) trials ($P<0.001$). There was no difference in postprandial TG concentrations between exercise trials.

Conclusions: The present study demonstrated that an acute bout of upper- and lower-body exercise matched for the total energy expenditure attenuates postprandial TG concentrations in healthy young men.

Keywords: Arm cranking exercise, cycling exercise, different modes of exercise, postprandial lipaemia

PAB(T4)-149
Nutrition intake among children with cow's milk allergy according to the degree of elimination

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Background and objective: Children with cow's milk allergy (CMA) have lower bone mineral density and shorter height than children without CMA or non-food allergy (FA), and their final height in adolescence is also affected. Thus, there is a need for appropriate nutritional guidance for CMA children. The purpose of this study was to conduct a dietary survey of CMA children and to compare their characteristics according to the degree of elimination.

Methods: A dietary survey of FA children attending the allergy clinic at Shiga Medical Center for Children, Shiga, Japan was conducted using the brief-type self-administered diet history questionnaire for Japanese children and adolescents (BDHQ15y). Additionally, the intake of soy milk, a common alternative food for CMA, was also determined using the same question format as for CM. To objectively assess the intake of vegetables and fruits, skin carotenoid levels were measured using the Veggie Meter®.

Results: Regarding the degree of CM elimination, of the 147 FA children recruited, 38, 27, and 82 children were in the complete-, partial-, and non-elimination groups, respectively. Significantly more intake of vegetable proteins, β carotene, α tocopherol, vitamin C, and polyunsaturated fatty acids, as well as significantly higher levels of skin carotenoids, were observed as the degree of CM elimination increased. On the other hand, significantly lower intake of calcium, animal proteins, vitamin B2, and saturated fatty acids were observed as the degree of CM elimination increased. In the complete-, partial-, and non-elimination groups, 16.7% (6/36), 40.0% (10/25), and 0.0% (0/74) drank more than one glass of soy milk per day, respectively.

Conclusions: The intake of many nutrients with antioxidant and anti-inflammatory effects was higher as the degree of CM elimination increased, presumably reflecting the caregiver's effort in identifying alternative foods. However, calcium intake was still inadequate, indicating the need for further encouragement of calcium intake for CMA children.

Keyword: Food allergy, Cow's milk allergy, Nutrition, children, Food elimination

PAB(T4)-150
Arab Women Adherence to the Mediterranean Diet and Insomnia

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Background and objectives: Sleeping difficulties affect overall health, nutrition, and wellbeing. The Mediterranean diet has proven effective in improving the quality of life and overall health of people of all ages. Therefore, this study aimed to determine whether adherence to the Mediterranean diet (MD) is linked to reduced insomnia in Arabic-speaking female adults in Jordan.

Materials and Methods: A self-administered, cross-sectional survey was used to detect the relationship between MD and sleep quality in Arabic-speaking female adults. Data were collected from 917 Arabic-speaking female participants of 14 Arab nationalities in Jordan between March and May 2021 via social media. All participants answered the whole questionnaire, including questions on sociodemographic aspects, Mediterranean diet adherence, sleeping habits measured with the Athens Insomnia Scale (AIS), and lifestyle components such as smoking and dietary patterns.

Results: The mean age of the 917 Arabic-speaking female participants was 36±10 years. Most participants were unemployed (85%) single females (64%) with an undergraduate degree (74%). Most of them (86%) were non-smokers. More than half of the participants were Jordanians (57%). The BMI was normal for 52% of the participants, whereas 26% of them were overweight, and 12% were obese. One-way ANCOVA showed a statistically significant difference between MD adherence score categories and AIS, F (2, 914) = 3.36, p = 0.015. Among the MD adherence score categories, we found that between groups, MD scores above or equal to 10 were associated with a statistically significant difference in AIS. Cohen's value was calculated for the three MD score categories and indicated a 'small' effect size association between all adherence scores of the MD categories and AIS.

Conclusions: In conclusion, our findings provide preliminary evidence that participants' adherence to the MD was significantly associated with better sleep and reduced insomnia symptoms, highlighting the need for further research.

Keywords: Mediterranean Diet, Insomnia, Arabic-speaking, Women, Dietary Patterns

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-151
Nutritive value, zinc bioavailability and glycemic index of “chin-chin,” bread and biscuit made from composite flours made from African yam beam, orange-fleshed sweet potato, plantain, maize, and wheat

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Background and objectives: The combination of legumes and cereals/tubers in a single meal or snack can help promote better nutrition and reduce the development of some chronic Non-Communicable Diseases (NCD), especially diabetes. The aim of this work was to determine the nutritive value, zinc bioavailability, and glycemic index of “chin-chin” bread and biscuit made from composite flours from indigenous.

Methods: *Sphenostylis stenocarpa* seeds were fermented in a citric acid medium (0.5%) for 24hrs at room temperature (28^{o}C) in a seed water ratio of 1:4 (w/v). *Zea mays* were sorted and fermented for 48hrs at room temperature (28^{o}C) in a seed water ratio of 1:3 (w/v). The fermented grains were separately dried and milled into flour for further use. Green matured *Musa paradisca* fruits were peeled, and sliced into a thin thickness of about 2 cm, and then dried in a food dehydrator (40- 50°C) for 24hr and milled into fine flour. Biscuits, ‘chin-chin' and bread were developed from the composite flours using standard methods. Standard laboratory methods were used for chemical analysis. Using 50g of anhydrous glucose as the reference food and 50g of available carbohydrate for the test food, the Glycemic Index (GI) of each food was determined by feeding them to 12 healthy subjects after an overnight fast. The incremental Area Under Curve (AUC) was used for the calculation of the GI of foods.

Results: The ranges of the chemical composition of the products were; α-carotenoid 612 -1042 mcg/100g, β-Carotene 646- 1146 mcg/100g, vitamin A (RAE) 69- 129mcg/100g. The phytate- zinc molar ratio of the products was low (0.00). The contributions of the 100g of the products to the Recommended Nutrient Intake (RNI) of adults ranged as follows: iron 7-99%, zinc 10-65%, phosphorus 38-51%, sodium 5-13%, vitamin A 11-18%, protein 21-30%, dietary fibre 13-39%, fat 4-12, available carbohydrate 33-52%. The Glycemic index (GI) of the products ranged from 15-63.

Conclusions: Availability and consumption of low GI foods made from indigenous raw food materials will enhance healthy diets and this might lower the number of health problems arising from poor dietary practices that leads to chronic non-communicable diseases.

Keywords: Glycemic Index, Diabetes, Composite Flour, African Yam Bean, Chemical Composition

PAB(T4)-152
Development of a genetic risk score to predict the risk of hypertension in European adolescents from the HELENA study

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Background and objectives: An increased prevalence of hypertension (HTA) has been observed in children and adolescents. In recent years, several single nucleotide polymorphisms (SNPs) have been associated with blood pressure levels. Therefore, a genetic risk score (GRS), combining a number of SNPs, could be a useful genetic tool to identify the predisposition to HTA from early life. For this reason, the aim of our study was to build a GRS being able to predict the genetic predisposition to hypertension in European adolescents. Methods: Data were extracted from the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) cross-sectional study. A total of 869 adolescents (53 % female), 12.5-17.5 years were included, with complete genetic and blood pressure (BP) information. BP levels were measured and cut-off points (≧ 130 mmHg for systolic and/or ≧ 80 mmHg for diastolic) were established for hypertension according to the recommendations. From a genome-wide association study all available SNPs from 57 BP-related genes were selected to construct a GRS. Moreover, Linkage disequilibrium (LD), (r2>0.8), Hardy-Weinberg equilibrium (<0.05) and Major Allele Frequency (MAF) (>0.9) filters were applied, to obtain a final number of 1534 SNPs available for the present analysis. First, a screening of SNPs univariately associated with BP (p<0.10) was established, obtaining a final number of 16 SNPs significantly associated to BP (p< 0.05) in the multivariate model. The unweighted GRS (uGRS) and weighted GRS (wGRS) were calculated.

Results: The area under the curve (AUC) was calculated and validated using ten-fold internal cross-validation for uGRS (0.7631) and wGRS (0.7659). When other covariates of interest were added to the analyses, the AUC obtained increased their predictive ability (uGRS: 0.8102; wGRS: 0.8127 for z-BMI; uGRS: 0.8644; wGRS: 0.8711 for z-BMI plus pure fructose from non-natural foods). Furthermore, there were significant differences between AUC with covariates, BMI-z alone and BMI-z plus pure fructose from non-natural foods, and without them (p<0.001).

Conclusions: Both GRSs, the uGRS and wGRS could be used to evaluate the predisposition to HTA in European adolescents. Moreover, the inclusion of z-BMI and pure fructose from non-natural foods increased the predictive ability of the BP specific GRSs.

Keywords: Genetic risk score, Hypertension, Blood pressure, Adolescents

PAB(T4)-153
Aryl hydrocarbon receptor-mediated modulation of the body clock and wasting syndrome

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Background and objectives: The circadian rhythm of living organisms is regulated by oscillations of the expression of clock genes. Abnormal expression of clock genes leads to disturbance in the circadian rhythm. Aryl hydrocarbon receptor (AhR) is a transcription factor whose ligands are environmental pollutants including benzo[a]pyrene (B[a]P), and it has been reported that activation of AhR induces wasting syndrome and disrupts the biological clock. However, the effect of AhR on circadian rhythms in adipose tissue has not been clarified. Therefore, the aim of this study is to clarify the relationship between disruption of clock gene expression and AhR-induced wasting syndrome.

Method: 3T3-L1 cells were differentiated into mature adipocytes and used this study. Adipocytes were synchronized to circadian rhythms by serum stimulation, and B[a]P was treated to the cells for 60 hours. mRNA and protein expression levels of clock genes were measured by qPCR and Western blotting, respectively. A dual-luciferase assay was used to examine the involvement of DNA-binding sequences that regulate the expression of clock genes. Lipid accumulation was estimated by Oil Red O staining.

Results: B[a]P decreased both mRNA and protein expression of Brain and muscle arnt-like protein-1 (BMAL1), and Circadian locomotor output cycles kaput (CLOCK). B[a]P reduced the transcriptional activity of BMAL1 and CLOCK through the RORE region. B[a]P did not alter the expression level of REV-ERBα, a transcription factor of BMAL1 that binds to the RORE region, but it did increase the nuclear accumulation. B[a]P decreased lipid accumulation into the cells as symptom of wasting syndrome. Furthermore, B[a]P suppressed fatty acid uptake, fatty acid synthesis, and differentiation of adipocytes, but knockdown of AhR and BMAL1 by siRNA cancelled them.

Conclusion: Activation of AhR increases the nuclear accumulation of REV-ERBα, causes RORE-mediated transcriptional repression of BMAL1. In addition, AhR activation causes dysfunction of lipid metabolism such as fatty acid synthesis, its uptake, and differentiation of adipocytes via reduced BMAL1 expression. Taken together, these results indicate that disruption of clock gene expression is involved in the onset of wasting syndrome.

Keywords: Aryl hydrocarbon receptor, clock genes, wasting syndrome

PAB(T4)-154
Utilizing stockpiled foods for Preparing Therapeutic Foods in Disasters

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Background and objectives: In the event of a large-scale disaster, it is difficult to obtain special nutritional foods due to the disruption of distribution channels, and there is concern that the health status of people requiring special care will deteriorate. This is particularly true for those with chronic diseases requiring special nutritional foods. These foods, however, have short expiration dates and few local governments stockpile them. To remedy this, the Ministry of Agriculture, Forestry and Fisheries recommends stockpiling these foods at people's homes. However, depending on the timing of the disaster, it is possible that there will not be any food stocks. Therefore, we examined whether it is possible to make therapeutic foods at home using foods that stored at room temperature and have a best-by date of one year or more.

Methods: We considered four therapeutic diets, low-salt diet, low-protein diet, energy-control diet and lipid-control diet. The cooking method is to put the ingredients and seasonings in a heat-resistant plastic bag and boil them in a water bath. First, a general diet was prepared using the intake target amounts set by the Ministry of Health, for each therapeutic diet.

Results: Even when there was no stock of special foods at home, it was possible to make therapeutic foods at home using foods that could be stored at room temperature. The low-protein diet was deficient in vitamins B_1 and B_2 because it excluded the use of canned mackerel, which is high in protein. Since protein was restricted, energy was also reduced, so cookies were added to provide energy and improve pfc balance.

Conclusions: Therapeutic foods can be made at home, but in the event of a disaster, vitamins B_1 and B_2 are deficient due to lack of vegetables. Then this can be supplemented by using canned foods rich in vitamins B_1 and B_2. Furthermore, it is desirable to prepare sweet snacks or desserts to adjust energy.

Keywords: Disasters, stockpiled foods, Therapeutic Foods

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-155
Genetic hemoglobin disorders and their association with biomarkers of nutritional anemia: A review

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Background and objectives: Genetic hemoglobin disorders are autosomal recessive conditions that can result in a decreased production of hemoglobin or structurally variant forms of hemoglobin. Certain genetic hemoglobin disorders are thought to cause higher red blood cell turnover, due to chronic hemolysis and increased erythropoiesis. Requirements of nutrients involved in erythropoiesis, including iron, zinc, folate, vitamins B6 and B12, and riboflavin are therefore thought to be increased in individuals with genetic hemoglobin disorders, especially if dietary intake is marginal. Conversely, deficiencies of these micronutrients can contribute to significant alterations in erythropoiesis. We aimed to systematically review the literature for studies that measured ferritin, soluble transferrin receptor (sTfR), zinc, folate, vitamin B12, vitamin B6, and riboflavin concentrations in individuals with genetic hemoglobin disorders as compared with controls.

Methods: A systematic scoping review of English-language observational studies, with no limit on year of publication, was conducted.

Results: Findings from 167 studies were included. In study populations with genetic hemoglobin disorders, concentrations of mean or median ferritin and sTfR were higher compared with control study populations, and concentrations of zinc were lower than compared with control study populations. Vitamins B12 and B6 tended to be either lower or similar in those with genetic hemoglobin disorders as compared to control populations. For folate, discrepancies in the literature were found as to whether concentrations differed among those with and without genetic hemoglobin disorders, which may be attributable to the routine use of prophylactic high-dose folic acid supplementation in some populations, especially among those with sickle cell disease. Erythrocyte glutathione reductase activation coefficients (EGRac), an indicator of functional riboflavin deficiency, tended to be either higher or similar in those with genetic hemoglobin disorders as compared to control populations; however, data on this nutrient are limited to only four studies.

Conclusion: In individuals with some genetic hemoglobin disorders, biomarkers of nutritional anemia may not accurately represent an individual's nutritional status, and nutritional deficiency prevalence may be falsely underestimated or overestimated.

Keywords: Genetic hemoglobin disorders, Iron, Zinc, B vitamins

Conflict of Interest Disclosure: The authors have no conflicts of interest to disclose.

PAB(T4)-156
The physiological function ZIP14 in manganese metabolism

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Background: Manganese is an essential nutrient. Manganese homeostasis needs to be tightly controlled to prevent the adverse effects caused by its deficiency or overload. In this control, both the intestine and the liver play important roles—The intestine regulates dietary manganese absorption; whereas the liver clears manganese from the blood and secretes manganese into the bile for subsequent intestinal reabsorption or fecal excretion. As a newly identified manganese transporter, ZIP14 is abundantly expressed in the liver and small intestine. In humans, loss-of-function mutations in *ZIP14* result in severe neurodegeneration due to manganese hyper-accumulation in the brain; similarly, mice with whole-body *Zip14* knockout display manganese overload in the blood and brain, indicating an indispensable role for ZIP14 in regulating systemic manganese homeostasis. However, our knowledge on the transport of manganese by ZIP14 is limited and the functions of ZIP14 in the intestine and liver are not well understood.

Study objective: The current study aims to determine the tissue specific function of ZIP14 in the intestine and liver.

Methods: To establish the tissue-specific function of ZIP14 in manganese homeostasis, we generated mice with intestinal or/and hepatic *Zip14* knockout. Immunoblot analyses were used to confirm liver- and intestine-specific deletion of ZIP14. Inductively coupled plasma mass spectrometry (ICP-MS) analysis was used to measure tissue manganese content.

Results: In liver-specific *Zip14* knockout mice, hepatic manganese was significantly reduced, but brain manganese level was similar to that of the control animals, suggesting that although required for the liver to acquire manganese, hepatic ZIP14 is not essential for the maintenance of systemic manganese homeostasis. In contrast, in mice with ZIP14 deletion in the intestine, or in both the intestine and the liver, the brain manganese content increased significantly, indicating that loss of ZIP14 in the intestine increases body manganese loading.

Conclusions: Our study identified the critical role of intestinal ZIP14 in regulating systemic manganese homeostasis, and provided novel insights into how manganese homeostasis is regulated and how individuals lacking functional ZIP14 develop manganese overload.

Keywords: Manganese, ZIP14, Intestine, Liver

PAB(T4)-157

Effectiveness of a Locally Produced, Fish-Based Ready-to-Use Therapeutic Food on Weight gain and Micronutrients status among Cambodian Children in the Treatment of Acute Malnutrition; A randomized Controlled Trial

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Background and objective: Acute malnutrition (AM) remains a global health concern associated with low weight and micronutrient deficiencies in Cambodia. Low acceptability was found for standard ready-to-use-therapeutic-food (RUTF) products. Therefore, NumTrey, a locally-produced fish-based RUTF, was developed. The objective was to evaluate the effectiveness of NumTrey compared to an imported milk-based RUTF for weight gain and micronutrient status among 6-59-months-old children for home treatment of acute malnutrition.

Methods: Effectiveness was assessed in a single-blinded randomized controlled trial with weight gain as the primary outcome. Anthropometry was measured at baseline and bi-weekly follow-ups until endline (week 8). Biomarkers of vitamin A status (retinol-binding-protein (RBP)), iron status (ferritin and soluble transferrin receptor (sTfR)), and inflammation (C-reactive protein (CRP) and alpha-1 acid glycoprotein (AGP)) were collected at admission and discharge. Vitamin A deficiency was defined as RBP <0.70 µmol/L, low body iron as body iron (BI) <0 mg/kg, and deficient iron stores as ferritin <12 µ/L.

Results: In total, 121 children were randomized to BP-100 (n=61) and NumTrey (n=60). There was no statistical difference in weight gain between the groups (1.06 g/kg/day</95% CI (0.72, 1.41) and 1.08 g/kg/day; 95% CI (0.75, 1.41) for BP-100TM and NumTrey, respectively). Although the ability to conclude was limited by lower weight gain than the desired 4 g/kg/day in both groups, no superiority was found for any RUTFs. There was no significant difference in haemoglobin, ferritin or sTfR concentrations between admission and discharge. Body iron was 0.2 mg/kg lower at discharge, and there was a tendency towards a lower RBP. Prevalence of low BI increased significantly during the treatment (15% *vs* 16%, OR=23, *P*=0.000), but there was no impact on iron stores. RBP increased from 1.2 µmol/L to 1.4 µmol/L (*P*=0.566), and marginal vitamin A deficiency was reduced by 5.2%. Vitamin A deficiency prevalence was moderate at admission and discharge (6% and 3%, respectively). The prevalence of inflammation was high (>30%).

Conclusions: A locally produced fish-based RUTF effectively treats AM; however, more research is needed to improve the micronutrient status during SAM treatment among children.

Keywords: Severe acute malnutrition, Ready-to-use therapeutic foods, Effectiveness, Weight gain, Micronutrients

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

Further Collaborators: NA

PAB(T4)-158

Effects of Asian-based oil blends made from refined rice bran, flaxseed and sesame seed oils on lipoprotein particle size distribution

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Background and objective: Low density lipoprotein (LDL) cholesterol particle size distribution have implications on atherosclerosis risk. As part of a dietary intervention trial where volunteers consumed either one of two vegetable oil blends made with different proportions of refined rice bran, flaxseed and sesame seed oils, or refined olive oil (control), the objective of this study was to determine the effects of consuming these oils on the distribution of the LDL subfractions.

Methods: This secondary analysis was undertaken using serum samples collected as part of the 8-week, three-arm, parallel design, randomised controlled trial in 135 borderline hypercholesterolemic older Chinese adults. LDL subfractions analysis were conducted using the Lipoprint LDL system.

Results: There were significant reductions in intermediate density lipoprotein (IDL) cholesterol concentration in all three intervention groups over time (-6.07%; <0.001), though this was accompanied by a corresponding increase in small, dense LDL-C (sdLDL-C) (+24.7%; <0.05) and non-significant changes in large, buoyant LDL-C (lbLDL-C) (p=0.77). The concentration of VLDL-C was also reduced in all three interventions over time (-8.23%; <0.0001), whereas no significant changes in mean LDL particle size nor high density lipoprotein (HDL) cholesterol were observed. None of the treatment or time x treatment comparisons were significant.

Conclusions: The effects of the two oil blends on LDL subfractions were comparable to that of refined olive oil, with LDL-cholesterol lowering effects elicited mainly through the reduction of IDL-C. Given the preferential reduction of cholesterol from larger, buoyant lipoproteins alongside a small but significant increase in sdLDL-C, with minimal changes in overall LDL particle size, the long-term cardiovascular impacts of these dietary interventions remain to be determined.

Keywords: Blended oil, LDL cholesterol subfractions, Phytosterols, Rice bran oil, Unsaturated fatty acids

Conflict of Interest Disclosure: This project has been jointly funded by the Agency of Science Technology and Research (ASTAR), Singapore, and Wilmar International Limited. KLHW is a current employee of Wilmar International Limited. The other authors report no conflicts of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-159
The effect of body phenotype in hemodialysis patients on cardiovascular disease

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Background and objectives: The cardiovascular cause of death in end stage of renal disease (ESRD) patients is 10-20 times higher in the healthy population and accounted for more than half of all death. Insulin resistance (IR) is with high prevalence in the ESRD patients. IR is a risk factor for CVD and strongly associates with other CVD risk factors, such as: dyslipidemia, hypertension, and inflammation. The homeostatic model assessment of insulin resistance index (HOMA-IR) is used to assess IR. This study objective is to investigate the association between body phenotype and cardiovascular disease (CVD) risks of hemodialysis patients.

Methods: We conducted a cross-sectional study between 2013 and 2017, on 383 hemodialysis patients (male: n = 222, 58%) from seven hospital-based-dialysis centers, Taiwan. The patients' medical records were reviewed and body composition data, blood samples were collected at the first dialysis session in monthly examination. Body phenotype is classified according to BMI (normal weight:18.5-24.9) and fat mass percentage (FM %, male: 25%, female: 35%) into underweight (UW) (BMI <18.5), Normal weight/ nonobese (NW), Normal weight/ obsess (NWO), overweight-obese (pre-OB). We analyzed the traditional and nontraditional CVD risk factors among different body phenotype by using Student's t-test and ANOVA post hoc Tukey's test, Spearman rank correlation to evaluate the correlation between BMI, body composition and other clinical variables.

Results: Both NOW group and pre-obese group have higher triglyceride and HOMA-IR, lower high-density-lipoprotein cholesterol than UW group and NW group. NOW group has higher AC sugar than others. There are positive correlation between FM% and total cholesterol, low-density-lipoprotein cholesterol, triglyceride, AC sugar, insulin, HOMA-IR, high sensitivity C reactive protein.

Conclusion: Both NOW group and pre-obese group have higher cardiovascular disease risks than NW and UW patients.

Keywords: Hemodialysis, obesity, obese phenotype, cardiovascular disease

PAB(T4)-160
Blood levels of some nicotinamide adenine dinucleotide-related metabolites correlate with hearing acuity in healthy older men

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Background and Objectives: Age-related hearing loss (ARHL) is one of typical phenomena observed during aging. Although nicotinamide adenine dinucleotide (NAD+) metabolism is known to be associated with a variety of age-related disease, there are few findings in relation between ARHL and NAD+ metabolism.

Methods: This study is conducted as a sub-analysis in the Nicotinamide mononucleotide supplementation clinical trial. Blood levels of NAD+-related metabolites at the first visit of 42 older men were correlated with their hearing ability. In the hearing test, only air conduction was measured, and the pure tone hearing was evaluated at frequencies of 125, 250, 500, 1000, 2000, 4000 and 8000 Hz. Correlations were analyzed by the Spearman's rank correlation.

Results: Positive associations between nicotinic acid (NA) and right-ear hearing ability (indicating correlations between NA and hearing loss) in frequencies of 1000 Hz ($r = 0.480$, $p = 0.001$) and 2000 Hz ($r = 0.507$, <0.001) were observed. Moreover, positive associations between NA and left-ear hearing ability in frequencies of 1000 Hz ($r = 0.422$, $p = 0.003$), 2000 Hz ($r = 0.629$, <0.001) and 4000 Hz ($r = 0.366$, $p = 0.029$) were identified. In contrast, a negative association between nicotinic acid riboside (NAR) and right-ear hearing ability (indicating correlations between NAR and improving hearing ability) in frequencies of 125 Hz ($r = -0.396$, $p = 0.009$) was observed. Furthermore, NAR was positively correlated with left-ear hearing ability at frequencies of 1000 Hz ($r = 0.335$, $p = 0.030$) and 2000 Hz ($r = 0.390$, $p = 0.011$). There are also positive associations between nicotinamide (NAM) and left-ear hearing ability in the frequencies of 250 Hz ($r = 0.356$, $p = 0.021$) and 2000 Hz ($r = 0.371$, $p = 0.016$).

Conclusions: There is a positive correlation among the blood concentrations of NA, NAR and NAM and hearing loss at mainly 1000 Hz and 2000 Hz. This finding suggests that the NAD+ metabolic pathway could be associated with the onset and progression of ARHL.

Keywords: Nicotinamide adenine dinucleotide (NAD+), NAD+ metabolites, nicotinic acid, age-related hearing loss (ARHL), aging

Conflict of Interest Disclosure: This study was funded by Mitsubishi Corporation Life Sciences Limited, and the firm provided NMN. The Authors Yuichiro Fukamizu, Toshiya Sato, and Takanobu Sakurai declare no competing non-financial interests, but do declare the following competing financial interests: they are employees of Mitsubishi Corporation Life Sciences Limited. The other authors declare no competing interests.

PAB(T4)-161
Food is medicine: pilot testing a 'Produce Prescription' program in Australia

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Background and objectives: There is growing interest in *Food is medicine* programs to provide healthy foods as a treatment for patients, particularly those experiencing food insecurity. We aimed to test the feasibility of a healthy 'Produce Prescription' program and its impact on diet quality for people with type 2 diabetes (T2D) and consistently high blood glucose experiencing food insecurity in Australia.

Methods: A pre-post intervention study with n=50 participants recruited from a major public hospital in Sydney, Australia. Adults experiencing food insecurity with T2D and HbA1c ≧8% at the most recent clinical assessment, were eligible. Once enrolled, participants received healthy food boxes delivered weekly free of charge, with the contents sufficient to create 2 meals per day, 5 days per week for the entire household, over 12 weeks. Participants were also provided with tailored recipes that could be prepared using the contents of the boxes and behavioral change support from dietitians fortnightly. The primary outcome was change from baseline to week 12 in diet quality assessed by 24-hour diet recalls. Secondary outcomes included differences in cardiovascular risk factors; blood micronutrient status; body weight; and feasibility and acceptability indicators.

Results: Participants varied by ethnicity, with mean±SD age 63±9 years, HbA1c 9.8±1.5%, BMI 33.8±7.5 kg/m^2 and 46% were female. Overall, 92% completed the study. Compared to baseline, diet quality improved at week 12, with an increase in the mean overall diet quality (the Alternate Healthy Eating Index score) of 12.9 (95% CI: 8.7 to 17.1, *P*<0.001), driven by significant improvements in vegetables, fruits, whole grains, red/processed meat, trans fat, sodium, and alcohol consumption. Blood lipids also improved (total: HDL cholesterol ratio, -0.48, 95% CI -0.72 to -0.26, *P* <0.001), and there was significant weight loss (-1.74, 95%CI -2.80 to -0.68 kg, *P*=0.002), but no substantial changes in other clinical outcomes. Participants reported high levels of satisfaction with the Produce Prescription program.

Conclusions: These findings provide strong support for an adequately powered randomized trial to assess longer term effects of Produce Prescription as an innovative approach to improve clinical management of T2D.

Keywords: Produce prescription, Food insecurity, Food is medicine, Type 2 diabetes, Treatment

Conflict of Interest Disclosure: None

Further Collaborators: Nirupama Wijesuriya, Kellie Nallaiah, Thomas Lung, Gian Luca Di Tanna, Miaobing Zheng, David Simmons, Amanda Gauld, Maria Constantino, Margaret McGill.

PAB(T4)-162
Association of the inflammatory balance of diet and lifestyle with colorectal cancer among Korean adults: a case–control study

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Background and objectives: Dietary and lifestyle exposures may affect the risk of colorectal cancer (CRC) by promoting chronic inflammation. In this study, we assessed the separate and joint associations of dietary and lifestyle inflammation scores (DIS and LIS, respectively) with CRC.

Methods: Data from 919 pathologically confirmed CRC cases and 1846 age and sex-matched controls recruited at National Cancer Center Korea were analyzed. We calculated DIS and LIS that characterize the collective contributions of 19 food groups and 4 lifestyle components, respectively, to systematic inflammation by applying weights based on high-sensitivity C-reactive protein. Higher score indicates greater proinflammatory exposure. Unconditional logistic regression models were used to estimate the ORs and 95% CIs for CRC risk by DIS and LIS tertiles with adjustment for potential confounders. The lowest tertile served as the reference group.

Results: The highest DIS tertile group had significantly increased odds of having CRC (OR 2.67, 95% CI 2.11–3.38) and the odds increased with increasing DIS. The highest LIS tertile group had higher odds of having CRC (OR 1.28, 95% CI 1.03–1.58). In the cross-classification analysis, the odds of having CRC increased as DIS and LIS jointly increased until DIS reached the highest tertile, where the risk was very high (3-fold or more) regardless of LIS.

Conclusions: Higher balances of pro- relative to anti-inflammatory dietary and lifestyle factors, especially dietary factors, were associated with higher CRC risk among Korean adults.

Keywords: diet, lifestyle, inflammation, colorectal cancer

PAB(T4)-163
Survey on the preparation of low-salt diets in Chubu region hospitals

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Background and objectives: High sodium intake is related to many diseases, such as cardiovascular disease, and providing a

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

low–salt diet to patients in medical facilities is often necessary. The purpose of this study was to examine the methods used to adjust and prepare low-salt diets at hospitals in Japan.

Methods: In 2016, we mailed a questionnaire to 252 general hospitals with ≧200 beds in 8 prefectures in the Chubu region; central region in Japan; Seventy-seven facilities were analyzed ‹response rate of 30.6%›.

Results: The average number of meals served at the facilities was 259.3±119.8, and average percentage of low-salt meals to total number of meals ratio was 20.8±11.7%. The most common method for reducing salt was, "using low-salt seasonings"‹58 facilities›. We divided the methods for salt reduction into two: "simple" ‹e.g.,removing ingredients, reducing the amount of each serving› and "complex" ‹e.g.,changing the cooking method›. The average length of hospital stay was significantly shorter in facilities using simple methods ‹n=31› than in those using complex methods ‹n=46, 14.0±5.6 d,32.1±60.5 d; <0.001›. In addition, patients tended to highly rate the diets of facilities that used various salt reduction methods.

Conclusions: A low-salt diet was provided at all facilities; however, the cooking methods were diverse. It was noted that the methods for adjusting the salt content of the diet varied across the facilities, especially in those with long-term inpatients. Furthermore, it was observed that the use of diverse methods for preparing the low-salt diet received high ratings in the preference survey. However, there are few facilities that measure salt content on a regular basis, suggesting that objective evaluation is necessary to provide properly rationed meals.

Keywords: Low-salt diets, methods, medical facilities

PAB(T4)-164
Effects of mild magnesium deficiency on depressive-like behavior and metabolome of urine and plasma in rats

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Background and objectives: Epidemiological studies suggest that low magnesium (Mg) intake increased the risk of various diseases such as diabetes and depression. In addition, reliable method to identify mild Mg deficiency has not been established yet. For the biomarker discovery, we speculate that metabolomic analysis will be effective because Mg can affect various metabolism in the body. In the present study, we evaluated whether mild Mg deficiency could affect depressive-like behavior and metabolome of urine and plasma in rats.

Methods: Male Wistar rats (five-week-old) were fed a control diet formulated according to AIN-93G or low Mg diet containing 25% or 50% of Mg compared with the control diet. One-day's urine was collected on days 7, 14, 21, and 28. Open field test and forced swim test were conducted on days 29-35 to evaluate effects on locomotor activity and depressive-like behavior, respectively. On day 35, plasma was collected. The urine and plasma were subjected to untargeted and semi-quantitative metabolomics by gas chromatography-tandem mass spectrometry.

Results and discussion: Locomotor activity and depressive-like behavior were not affected by the treatments. Urinary excretion of Mg and plasma Mg level were decreased by low Mg diet while body weight and feed intake were not affected. In the urine, 29 out of the 122 annotated metabolites were affected by the diet. At all-time points from 7 to 28 days, there was a marked decrease of the excretion of some TCA cycle organic acids, especially citrate. In the plasma, only glycyl-glycine out of the 93 annotated metabolites were moderately affected.

Conclusion: Depressive-like behavior were not affected by mild Mg deficiency in rats. The deficiency clearly affects the urinary excretion of some metabolites. Further study should be done to evaluate whether these urinary metabolites can be the biomarker for mild Mg deficiency.

Keywords: Mild magnesium-deficiency, Depressive-like behavior, Metabolomics, Urine, Rats

PAB(T4)-165
Statins for hypercholesterolemia tend to decrease plasma ACBP/DBI concentrations

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Background and objectives: ACBP (Acyl-CoA Binding Protein)/DBI (Diazepam Binding Inhibitor), a highly conserved 10-kDa polypeptide, has been implicated in various physiological processes including acyl-CoA binding and transport, g-aminobutyric acid type A receptor binding, steroidogenesis, and peptide hormone release. It was reported that the plasma concentration of ACBP/DBI is positively correlated with BMI, and it is known that plasma ACBP/DBI concentration is significantly higher in severely obese patients and conversely decreases in loss of appetite. These reports indicate that ACBP/DBI may be considered a new appetite-promoting factor, but the evidence is still insufficient.

Methods: In this study, we measured plasma ACBP/DBI concentration in type2 diabetic patients visiting Hirosaki University Hospital (16 males, 12 females; 72.7±9.4 age) and investigated the association with statins, a therapeutic drug for hypercholesterolemia with DBI (Human) ELISA kit (Abnova).

Results: As a result, there was no correlation between the ACBP/DBI plasma concentration and the patient's body weight (statin-treated; 70.2±12.9 kg, statin untreated; 72.3±14.1 kg), body fat percentage (34.7±10.1%, 36.5±9.6%, respectively), LDL-Cho (109.1±30.7, 112.8±19.2 mg/dL, respectively) nor BMI (27.2±5.5, 28.5±4.1, respectively). Furthermore, plasma ACBP concentrations tended to be lower in the statin-treated group (144.2±29.8 ng/mL) than in the untreated group (173.6±54.3

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

ng/mL), although Welch's t-test results showed no significant differences (*P*=0.055).

Conclusions: This study found that in patients with type2 diabetes, those taking statins tend to have lower plasma ACBP/DBI concentrations than those not taking statins. The number of patients in this study was small, and future studies with larger numbers of subjects are needed to clarify the relationship between statins and ACBP/DBI. In addition, patients were taking multiple medications, so further investigation is required to determine if this is due to statins alone.

Keywords: ACBP/DBI, type2 diabetes, cholesterol

PAB(T4)-166
Effect of hyperglycemia during pregnancy on brain neurons in infants

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Background and objectives: Child from the gestational diabetes mellitus (GDM) with hyperglycemia during pregnancy develop neonatal complications such as macrosomia, myocardial hypertrophy, and neonatal hypoglycemia. Furthermore, it has been already reported that when infants of GDM grow up, they have a higher incidence of learning disabilities and attention-deficit/hyperactivity disorder (ADHD), and an increased rate of neurological dysfunction. In this study, we examined the effects of hyperglycemia during pregnancy on infant using a rat animal and cell model of GDM. We further examined whether n-7 unsaturated fatty acids ameliorate the effects of hyperglycemia using GDM cellular model.

Methods: GDM animal model rats were prepared by tail vein administration of streptozotocin to Wistar rats on day 2 of gestation. The cerebrum of infants of GDM rats (IDM rats) and infants of control mother rats (ICM rats) were examined. In addition, the rat pheochromocytoma cells (PC12 cells) were cultured in 500 mg/dL glucose to create GDM cellular model. Control cells were cultured with 200 mg /dL glucose. The effect of fatty acids on the PC12 cells was examined by adding the GDM model cells with the cis - palmitoleic acid (CPA) and the trans - palmitoleic acid (TPA), structural isomers of palmitoleic acid, an n-7 unsaturated fatty acid that has been reported to improve insulin resistance.

Results: The advanced glycation end-products (AGEs) generation was enhanced in the cerebrum of IDM rats on postnatal day 2 and the expression level of the receptor (RAGE) for AGEs was increased. The phosphorylation level of Akt was decreased in IDM rats. In GDM cellular model, the generation levels of AGEs were enhanced, the phosphorylation levels of Akt and JNK were inhibited. In GDM cellular model exposed to hyperglycemia, cleaved caspase and Bax were increased and the number of apoptotic cells increased compared to control cells. However, the induction of AGEs and inflammation was suppressed, and the number of apoptotic cells decreased by treated with CPA or TPA. However, CPA was cytotoxic in a concentration dependent manner.

Conclusions: Hyperglycemia during pregnancy increases AGEs and induces apoptosis on brain neurons, suggesting that dairy products containing TPA may ameliorate these abnormalities by feeding during pregnancy.

Keywords: Intrauterine hyperglycaemia, advanced glycation end products, n-7 unsaturated fatty acids, infants, apoptosis

PAB(T4)-167
Vitamin E intake and Paraoxonase 1 (*PON1*) rs662 genetic polymorphism associated with colorectal cancer risk in a Korean population

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Background: Vitamin E and paraoxonase 1 (*PON1*) have essential roles in reducing oxidative stress, which may contribute to cancer development. However, their interaction on the risk of colorectal cancer (CRC) was inconclusive. We conducted a hospital-based case-control study to determine whether PON1 affects the antioxidant activity of vitamin E in CRC occurrence.

Methods: Total study sample comprised with 923 CRC cases and 1846 controls matched by age and sex at the National Cancer Center, Korea. Based on the genotype data, 589 cases and 810 controls were selected to perform interaction analysis. Dietary information was collected using a semiquantitative food frequency questionnaire (SQFFQ). Genotyping was carried out using an Illumina MEGA-Expanded Array. Unconditional logistic regression models were used to observe the associations and likelihood ratio tests were applied to observe the interaction.

Results: There was an inverse association between vitamin E intake and CRC risk (odds ratio (OR) = 0.26; 95% confidence interval (CI) = 0.21–0.33; *p* for trend <0.001) after adjusting for confounders. We identified a lower risk of CRC among homozygous CC carriers of the *PON1* rs662 polymorphism than participants having the T allele (CT+TT) (OR = 0.72; 95% CI=0.55–0.94; p=0.017). Among the individuals carrying the minor allele (T), the highest vitamin E intake was associated with a 70% reduced CRC risk compared to the lowest level (OR = 0.30; 95% CI = 0.19–0.49). The protective effect of dietary vitamin E against CRC development was stronger among CC individuals (OR = 0.11; 95% CI = 0.06–0.21; *p* for interaction=0.029).

Conclusions: The study supported the evidence that vitamin E intake was associated with CRC risk reduction. Furthermore, the activity of vitamin E was strengthened among homozygous CC carriers of the *PON1* rs662 polymorphism.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Vitamin E, Paraoxonase 1, PON1, rs662, Colorectal cancer

PAB(T4)-168
All-trans retinoic acid induces lipolysis via activation of autophagy in mouse adipocytes

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Background and objectives: Lipophagy is the new pathway of lipolysis that is defined as the breakdown of lipid droplets (LDs) via autophagy, a cellular homeostasis mechanism, in adipose tissue and liver. All-trans retinoic acid (atRA), a metabolite of vitamin A, has been thought to induce lipolysis by hormone-sensitive lipase (HSL) in mouse adipocytes. However, it is unclear whether atRA can be involved in lipophagy. In this study, we investigated the effects of atRA on autophagy in the epididymal fat of mice and on lipolysis through the activation of autophagy in mouse adipocytes (3T3-L1 cells).

Methods & Results: C57BL/6J mice were intraperitoneally administered 10 mg/kg body weight/day of atRA for 4 weeks. We confirmed that the epididymal fat mass and adipocyte size in atRA-treated mice were smaller than in DMSO-treated mice as a control. Western blotting analysis showed that atRA increased the expression of LC3B-II protein, but decreased the expression of p62 protein in the epididymal fat of mice. Oil Red-O staining indicated that lipid accumulation in differentiated 3T3-L1 cells treated with atRA (100 nM) for 10 days was lower than DMSO-treated cells. The treatment of Torin1, an autophagic inducer, or atRA for 24 h increased the release of fatty acids from LDs in differentiated 3T3-L1 cells. Furthermore, we verified that atRA activated autophagy flux in mature 3T3-L1 cells using the autophagy flux assay probe, GFP-LC3-RFP-LC3ΔG. Inhibition of autophagy using siRNA of autophagy-related gene 5 (ATG5) partially suppressed the atRA-induced release of fatty acids from LDs in differentiated 3T3-L1 cells.

Conclusions: These results suggest that atRA partly may induce lipolysis via activation of autophagy in adipocytes.

Keywords: All-trans retinoic acid (atRA), autophagy, lipolysis, adipocyte, obesity

PAB(T4)-169
Associations between polyunsaturated fatty acid intake and risk of dyslipidemia

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Background and objectives: cardiovascular diseases are the leading cause of death in Korea. Thus, efforts are needed to improve the lipid profile, a risk factor for cardiovascular diseases. Previous studies show the inverse relationship between the intake of polyunsaturated fatty acids (PUFA) and lipid levels, but studies conducted on Koreans are insufficient. Therefore, this study aimed to investigate the association between PUFA intake with the incidence of dyslipidemia and its components in Korean adults.

Methods: Data were obtained from the Korean Genome and Epidemiology Study (KoGES), a community-based prospective cohort study. Korean adults aged 40-69 years who did not have dyslipidemia components, hypertension, type 2 diabetes, cardiovascular diseases, or cancer at baseline and who participated in the diet survey using a semi-quantitative food frequency questionnaire were selected as subjects. The data of 2,629~6,270 subjects were utilized for final analyses. The new cases of dyslipidemia were defined as satisfying one or more of the following conditions: hypercholesterolemia, defined as total cholesterol ≧ 240 mg/dL; hyper-LDL-cholesterolemia, defined as LDL-cholesterol ≧ 160 mg/dL; hypo-HDL-cholesterolemia, defined as HDL-cholesterol <40 mg/dL for men and <50 mg/dL for women; hypertriglyceridemia, defined as ≧ 200 mg/dL; or have been diagnosed with dyslipidemia or taking lipid-lowering medications during follow-up. Subjects were classified into quintiles according to the PUFA intake. Cox proportional hazard model was used to analyze relative risks (RR) and 95% confidence intervals (95% CI) for incident dyslipidemia according to PUFA intake.

Results: During a maximum follow-up of 15.6 years, 1607, 1230, 1375, 1555, and 1233 cases were newly identified as dyslipidemia, hypercholesterolemia, hyper-LDL-cholesterolemia, hypo-HDL-cholesterolemia, and hypertriglyceridemia, respectively. After adjusting for confounders, subjects with the highest quintile of PUFA intake had a significantly lower risk of hypercholesterolemia (RR=0.77, 95% CI=0.61-0.96, P for trend=0.0081) and hyper-LDL-cholesterolemia (RR=0.74, 95% CI=0.60-0.92, P for trend=0.0087) than those who with the lowest quintile. However, there was no significant difference in risk of dyslipidemia, hypo-HDL-cholesterolemia, and hypertriglyceridemia according to PUFA intake.

Conclusions: The findings of this study imply that a higher PUFA intake may affect improving lipid profile among middle-aged Korean adults.

Keywords: Polyunsaturated fatty acids, Dyslipidemia, Korean adults, Cohort study

Further Collaborators: This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ01704702)" Rural Development Administration, Republic of Korea.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-170
Effect of phosphate on intestinal zinc absorption in 5/6 nephrectomized rats

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Background and objectives: Zinc is an essential trace element and maintains several important biological processes in human body by serving as a component of various enzymes and transcription factors. In chronic kidney disease (CKD), more than 80% of the patients show hypozincemia. Hypozincemia is one of the adverse prognostic factors of CKD. However, the pathogenesis of hypozincemia in CKD remains unclear and its treatment is not well established. Zinc homeostasis is mainly regulated by intestinal absorption. In this study, we aimed to elucidate the pathogenesis of hypozincemia in CKD, focusing on intestinal zinc absorption.

Methods: We performed experiments in normal rats and in a rat model of CKD generated by 5/6 Nephrectomy. To evaluate intestinal zinc absorption capacity of rats, the area under the plasma zinc concentration-time curve (AUC) was measured after administration of $ZnSO_4$ solution with or without phosphate. The solubility of zinc in the solution was examined using a 0.22 µm filter.

Results: CKD rats had lower plasma zinc levels and higher phosphate levels than those of control rats. The AUC in CKD rats after administration of $ZnSO_4$ alone was significantly decreased compared to control rats, suggesting that intestinal zinc absorption may be reduced in CKD. Renal dysfunction often leads to excess accumulation of phosphate in the body, including intestinal lumen. To explore the mechanisms of reduced AUC in CKD rats, we examined the relationship between phosphate and zinc metabolism. In rats fed a high-phosphate diet, plasma zinc levels significantly decreased compared to rats fed a control diet. Furthermore, we found that the AUC in normal rats decreased as increase in phosphate concentration of the administered solution. The solubility of zinc in the solution decreased in a phosphate concentration-dependent manner, which was also seen in the physiological intraluminal pH range (pH 6~8).

Conclusions: This study suggests that hypozincemia in CKD may be, in part, induced by excess phosphate, which reduces the solubility of intraluminal zinc and inhibits its absorption. Therefore, dietary phosphate restriction may help to ameliorate hypozincemia as well as hyperphosphatemia in CKD patients. Further clinical investigation will be needed.

Keywords: Hypozincemia, Chronic kidney disease, Intestinal zinc absorption, Zinc homeostasis, Hyperphosphatemia

PAB(T4)-171
Evaluation of impact of nutritional counseling on nutritional status of post-operative coronary artery bypass graft surgery patients

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Background and objectives: Modifying the diet via nutritional counseling is an emerging concept used to intervene nutrition imbalances that lead to malnutrition, chronic diseases, and other clinical conditions. In surgical patients, nutritional counseling supports fast recovery and reduces complications after surgery. Coronary artery bypass graft (CABG) surgery is used to treat cardiovascular diseases, which are increasing in Sri Lanka. However, studies determining effect of nutritional counseling for CABG patients in Sri Lanka are limited. Therefore current study employed a pre-post design to evaluate the impact of nutritional counseling on the nutritional status of post-operative CABG patients.

Methods: Thirty post-operative CABG patients (Males; 20, Females; 10), age >18 years were recruited from a private hospital. Post-operative nutritional counseling was provided at the hospital by a registered dietitian. Observations on nutritional counseling, patients' information sheets available with the dietitian, and a pre-tested interviewer-administered questionnaire via telephone were used for data collection. At baseline, data were collected on patients' general characteristics, medical information, nutritional status-related biochemical parameter information, and dietary information. At the first hospital visit after surgery, patients' length of wound healing period and biochemical parameters were obtained. Patients' pre-operative biochemical parameter information and dietary information were compared with post-operative biochemical parameter information and dietary information.

Results: Findings confirmed improved biochemical parameters from high levels to healthy range for random blood glucose level and serum albumin level in 6 (20%) and 5 (16.7%) patients respectively. Serum albumin level of 10 (33.3%) patients was improved from low level to healthy range. Length of wound healing period (Mean 3.07$\pm$1.2 weeks) was less than two weeks for 11 (36.7%) patients. After nutritional counseling, vegetable consumption of 10 (33.3%) patients was increased from <2 servings to 2-4 servings per day. Majority, 26 (86.7%) patients have changed their usage of coconut milk type from first milk to second milk for cooking meals.

Conclusions: According to the results, nutritional counseling positively impacted on nutritional status of post-operative CABG patients. Further studies are required on nutritional counseling for CABG patients in both government and private hospitals and the impact of nutritional counseling on other surgical procedures.

Keywords: Cardiovascular diseases, coronary artery bypass graft surgery, nutritional counseling, nutritional status, post-operative

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-172
MMS Process Evaluation in 10 Districts in Indonesia

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Background and objectives: Micronutrient deficiencies are common among pregnant women especially in LMICs. Multiple micronutrient supplement (MMS) has been shown to improve pregnancy outcomes and the World Health Organization (WHO) has provided a context -specific recommendation for MMS. This study examines inputs, processes, and outputs related to the implementation of MMS in 10 health office districts level in Indonesia.

Methods: An online ANC facility-based survey was conducted in 10 districts in Indonesia. Online forms were socialized with, and then sent to head of facility. Inputs examined included provision of existing MMS storage area, program implementation team, program operations manuals, and provision of broader MMS program awareness and socialization within district ANC system. Processes examined included feedback from pregnant women (e.g., MMS related questions, complaints, and side effects). Outputs included MMS distribution data in each districts.

Results: Most district (80%) had a well-managed storage facility for MSS. While few had a specific MMS implementation team (10%) and operations manual (20%), half (50%) had socialized the importance of MMS within broader health system. Across all district, no monitoring system existed to collect data on beneficiary feedback, however some recipients of MMS could report their questions or concerns to midwives via a previously established WhatsApp group. The amount of MMS distributed was recorded monthly at the level of 70% (based on number of doses allotted for each district).

Conclusions: District health facilities are distributing MMS to pregnant women via the ANC system. Improving s monitoring and evaluation protocols and efforts to better understand the strengths and weaknesses of current MMS implementation efforts will help health care providers (e.g., midwifes) within district-level health facilities improve the delivery of MMS.

Keywords: Monitoring, Evaluation, MMS, Distribution

Conflict of Interest Disclosure: No Conflict of Interest

Further Collaborators: Vitamin Angels

PAB(T4)-173
Factors influencing depressive disorder in late adulthood, Korea

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Background and Objectives: Depressive Disorder (DD) is the most common mental illness. It is known that the possibility of suffering from DD in the elderly attempted suicide is high. To improve the symptoms of DD, this study was conducted how dietary status works among factors, such as socio-economic characteristics, health behaviors, chronic diseases, and dietary behaviors (DB) affecting DD.

Methods: This study was conducted using data from KNHANES. The subjects were adults 65 years of age or older. Those diagnosed with DD by a doctor or had a PHQ-9 score of 10 or higher were classified as DD group. And normal group with the same gender and age were chosen using the Propensity Score Method, and all of 528 subjects were analyzed. Decision Tree method was used to predict factors influencing the prevalence of DD.

Results: The 1st factor influencing the prevalence of DD was quality of life, the second factor was stress recognition, current smoking status, and income level. The third factor was age, rheumatoid arthritis, folate intake ratio, mixed-grains intake, perception of nutritional labeling (NL), and food security (FS). Particularly, the probability of DD occurrence increased to 100% when the NL of food was not recognized even if stress was hardly recognized. In terms of DB, the first factor was FS. Even if FS is secured, if the mixed grain intake score was under 1.2 points, the probability of DD was increased. And when the intake of meat, fish, eggs, and beans was under 1.3 points, the probability of DD to 100%. If FS is mildly insecure, if the iron intake ratio is poor, the probability of DD was increased. And when the intake of n-6 intake ratio is poor, the probability of DD was also increased. The probability of DD occurrence increased when the NL of food was not recognized even if iron intake ratio was good.

Conclusions: It was found that various environmental factors had more influence on DD in late adulthood. However, DB is a factor that can be improved, and confirmed that recognizing NL and properly consuming foods affects the prevalence of DD.

Keywords: Depressive Disorder, nutritional labeling, Decision Tree, late adulthood, KNHANES

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-174
Maternal vitamin D deficiency may be a risk factor for enamel hypomineralization in permanent teeth of the fetus.

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Background and objectives: Vitamin D is one of the essential nutrients and especially important for hard tissue development such as bone and teeth, which require mineral deposition. The principal function of vitamin D in calcium and phosphate homeostasis is to increase those mineral absorptions from the intestine. Thus, its deficiency results in rickets and osteomalacia. In recent years, the number of rickets patients has been increasing not only in Japan but also in other countries. In dentistry, hypomineralization of a permanent tooth at 1st molars and/or incisors known as MIH is increasing, which could be related to vitamin D deficiency.

Methods: We analyzed the role of 1,25-Dihydroxyvitamin D3 in the differentiation of dental epithelial cells into ameloblasts and in the mineralization of the enamel matrix in vitro and tooth bud organ culture system.

Results: The expression of ameloblast marker genes were induced by 1,25-Dihydroxyvitamin D3 in dental epithelial cells and cultured tooth buds. Mineralization of enamel matrices secreted from ameloblasts was induced by 1,25-Dihydroxyvitamin D3, but was necessary in the presence of sufficient calcium.

Conclusions: Vitamin D as well as sufficient calcium is essential for enamel calcification. One key point of this presentation is that the bone phenotype of rickets patients improves and heals with active vitamin administration, but the calcification defects of the enamel cannot be corrected once the enamel has formed. This is because, unlike bone, teeth cannot be remodeled. In addition, vitamin D intake in pregnant and nursing women is important because the induction of ameloblast and the enamel mineralization of permanent teeth begin in the late phase of pregnancy. We believe that breastfeeding is wonderful, thus we would like to establish a system to check the nutritional composition of breast milk like a formular milk and if there is excess or deficiency, it can be improved with supplements for mothers.

Keywords: Vitamin D, Pregnant, bone, tooth, milk

Conflict of Interest Disclosure: We have no conflicts of interest to disclose.

PAB(T4)-175
The association of dietary potassium intake and the *TNF*-α rs1800629 polymorphism with gastric cancer risk: A case-control study in Korea

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Background: Dietary mineral intake has been suggested to have an impact on gastric cancer (GC) prevention; however, a protective effect against gastric carcinogenesis of potassium remains understudied. The causal link between inflammation and cancer was well established. Notably, potassium and potassium channels may have certain roles in the regulation of tumor necrosis factor-α (T*NF*-α) production. We determined whether dietary potassium intake has a beneficial effect on GC prevention and whether the effect of potassium on GC risk is modified by *TNF*-α rs1800629 single-nucleotide polymorphism.

Method: We designed a case-control study with 377 cases and 756 controls to investigate the association of dietary potassium intake with GC risk. A semi-quantitative food frequency questionnaire was used to identify dietary potassium intake. We used the Affymetrix Axiom Exom 319 Array platform to genetic analyze *TNF-α* rs1800629. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated based on logistic regression models.

Results: Dietary potassium intake was found to be inversely associated with GC risk (OR=0.63, 95% CI=0.45-0.89, *P* for trend=0.009). We observed an insignificant association of *TNF-α rs1800629* with GC risk (OR=1.01, 95% CI=0.68-1.49). Notably, the protective effect of potassium against gastric carcinogenesis may be modified by *TNF-α rs1800629*; in detail, potassium seemed to have a greater effect among females with GG homozygotes (OR (95% CI)=0.40 (0.20-0.78), *P* interaction=0.041).

Conclusion: Our study emphasized a beneficial effect of potassium intake on GC prevention. However, this effect depended on *TNF-α rs1800629* genotype. A greater effect was exhibited for females with GG homozygotes.

Keywords: Potassium, TNF-α rs1800629, gastric cancer, case-control study

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-176
Longer-term mixed nut consumption improves not only cardiometabolic risk markers, but also regional insulin action in the brain: Results of a randomized, controlled crossover trial in older adults

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Background and objectives: Improving brain insulin sensitivity is considered a promising approach in the prevention and treatment of age-related metabolic and cognitive diseases. This study therefore investigated the longer-term effects of mixed nuts on regional cerebral blood flow (CBF) responses to intranasal insulin in older adults. Furthermore, more traditional cardiometabolic risk markers were assessed.

Methods: In a randomized, single-blinded, cross-over trial, twenty-eight healthy adults (65±3 years; BMI: 27.9±2.3 kg/m^2) received either daily 60 g mixed nuts (15 g of walnuts, pistachio, cashew, and hazelnuts) or no nuts (control) for 16 weeks, separated by an 8-week washout period. Throughout the whole study, participants were requested to adhere to the Dutch food-based dietary guidelines. During follow-up, brain insulin action was assessed by quantifying acute effects of nasal insulin on regional CBF using arterial spin labeling MRI. Furthermore, peripheral insulin sensitivity using an oral glucose tolerance test (OGTT) and other cardiometabolic risk markers were assessed.

Results: Body weight and composition did not change during the study. Mixed nut consumption significantly affected regional insulin action in eight brain clusters. Four clusters were located in the left (Δ-4.5±4.7 mL/100g/min; <0.001; Δ-4.6±4.8 mL/100g/min; <0.001; and Δ-4.3±3.6 mL/100g/min; P=0.007) and right occipital lobe (Δ-4.3±5.6 mL/100g/min; P=0.028). Another cluster was part of the left frontal lobe (Δ-4.9±4.6 mL/100g/min; <0.001), while three other cortical clusters were located in the left and right parietal lobe (Δ-4.2±3.6 mL/100g/min; <0.001; Δ-4.7±3.7 mL/100g/min; <0.001; and Δ-3.9±4.9 mL/100g/min; P=0.028). Post-load concentrations during the OGTT and fasting glucose and insulin concentrations were however not affected. Finally, serum LDL-cholesterol concentrations (Δ-0.24 mmol/L; 95%CI: -0.44 to -0.04; P=0.019), and systolic blood pressure (Δ-5 mmHg; 95%CI: -8 to -1; P=0.006) and mean arterial pressure (Δ-3 mmHg; 95%CI: -6 to -1; P=0.020) were lower after the intervention as compared to the control period.

Conclusions: Longer-term mixed nut consumption as part of a healthy diet may improve in older adults insulin responsiveness in brain regions involved in the modulation of metabolic and cognitive processes. LDL-cholesterol concentrations and blood pressure levels also improved, but beneficial effects on peripheral insulin sensitivity were however not observed.

Keywords: Nuts, Brain, Insulin Sensitivity, Cerebral Blood Flow, Cardiometabolic Risk

Conflict of Interest Disclosure: This study was supported by a grant from the International Nuts and Dried Fruit Council (INC). The INC was not involved in the design, implementation, analysis, and interpretation of the study.

PAB(T4)-177
Unsaturated fatty acid supplementation maintains a healthy liver and improves intestinal morphometry in an animal model at an early age

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Background and objective: Obesity in children promotes an inadequate formation of adipocytes that would have repercussions in adulthood; this generates the need to look for new foods or components that favor the adequate establishment of adipocytes in early childhood, where oils are a great alternative due to their composition. Therefore, the objective was to evaluate the influence of the consumption of different sources of fatty acids such as quinoa oil (QO), fish oil (FO) and vegetable shortening (VS), on liver and intestinal morphometry in an animal model at an early age.

Methods: 76 Cobb 500 male chicks were used, divided into four treatments. The diets were provided for seven days, T1: basal, T2: basal+1% QO, T3: basal+1% FO and T4: basal+1% VS. At the end, all the animals were sacrificed to extract the liver for its weight and evaluation of macroscopic (MaC) and microscopic (MiC) characteristics, in addition to samples of the small intestine to determine its morphometry (length, width, area and depth of the crypt). Data were analyzed by Kruskal-Wallis considering P<0.05 as statistically significant, using the R Studio 4.1.1 program.

Results: The weight of the liver was greater in the T4 group compared to the other treatments (P<0.05), this is confirmed by the MaC and MiC, which indicated moderate injury and accumulation of fat globules in the hepatocytes, respectively. Whereas, the groups fed with QO or FO had normal and similar characteristics to T1. In reference to the intestinal morphometry, the animals fed with T2 and T3 obtained greater villus length compared to those fed with T1 and T4 (P>0.05); regarding the width and area of the villi, values were obtained in favor of the T2 treatment compared to the other treatments; however, there were no significant differences in crypt depth.

Conclusions: The consumption of diets supplemented with fatty acids from quinoa oil or fish oil improves intestinal morphometry, compared to vegetable shortening and basal diet. In addition, quinoa oil and fish oil help maintain the normal characteristics of the liver compared to vegetable shortening, which causes injuries and promotes the accumulation of fat in hepatocytes.

Keywords: Fatty acids, quinoa oil, liver, intestinal morphometry, early age

Conflict of Interest Disclosure: The authors of this communication declare that they have no conflict of interest.

Further Collaborators: To the National Program for Scientific Research and Advanced Studies that financed the research through contract No. 407-2019-PROCIENCIA.

PAB(T4)-178
The effects of pre-exercise high and low glycaemic index meals on substrate metabolism in inactive middle-aged women

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Background and objectives: Unhealthy diet and physical inactivity are the major risk factors for non-communicable diseases. Glycaemic index (GI) is an indicator of glucose absorption into the systemic circulation after ingestion of the same amount of carbohydrates from different foods. Given that lowered postprandial insulin after consuming low GI foods, the consumption of low GI foods has been shown to enhance fat oxidation and reduce carbohydrate oxidation compared with high GI foods during subsequent exercise. However, few studies have examined the influence of pre-exercise meal with different GIs in untrained adults performed feasible exercise. Thus, the aim of this study was to investigate the effect of high and low GI meals before exercise on substrate metabolism in inactive middle-aged woman.

Methods: Ten inactive middle-aged women (aged 42±6 years, mean ± standard deviation) completed two trials, high GI and low GI, in a randomised crossover design. Each participant consumed an isocaloric high GI or low GI breakfast (1.5 g/kg body mass carbohydrate) with GI values of 73 and 41, respectively 120 minutes before a 60-minute walk at 50% of maximum oxygen uptake. After performing a 60-minute walk, participants rested for 60 minutes. Expired gas samples were collected every 30 minutes for 15 minutes prior to walking, and further samples were collected continuously throughout the walking session and the entire 60-minute post-walking period.

Results: The pattern of fat oxidation response was different between trials (trial-by-time interaction, $P<0.0005$). Post hoc tests revealed that there was a tendency toward increased fat oxidation at 15 minutes into the waking period in the low GI trial ($P=0.117$). The pattern of carbohydrate oxidation response was different between trials (trial-by-time interaction, $P<0.0005$). Post hoc tests revealed that there was a tendency toward decreased carbohydrate oxidation at 15 minutes into the waking period in the low GI trial ($P=0.081$). These data were also confirmed by cumulative fat and carbohydrate oxidation analyses using data extracted from a 60-minute walk.

Conclusions: These findings may indicate that consuming a low GI breakfast have favourable effects on fat and carbohydrate metabolism during subsequent walking.

Keywords: Glycaemic index, substrate oxidation, walking, women

PAB(T4)-179
Effect of highly unsaturated fatty acid deficiency from birth on hepatic cholesterol accumulation and pathology

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Background and objectives: Highly unsaturated fatty acids (HUFAs), which are polyunsaturated fatty acids (PUFAs) with more than 20 carbons and three or more double bonds, are important components of biological membranes and are converted to lipid mediators that are important for the maintenance of homeostasis in the body. Fatty acid desaturase 2 (FADS2) is responsible for the conversion of C18 PUFA to C20 PUFA. We have previously reported that feeding adult FADS2-deficient mice a PUFA deficient-diet resulted in a marked decrease in HUFAs and accumulation of both triglyceride and cholesterol in the liver (FEBS letters, 2021). In this study, we examined cholesterol accumulation and pathology in the liver of FADS2-deficient mice fed a PUFA-deficient diet from birth.

Methods: The parental FADS2 heterozygous deficient mice were fed the experimental diet immediately after birth. Wild-type and FADS2-deficient pups were weaned at 4 weeks of ages. Each pup was fed the same diet as the mother and dissected at 12 weeks of ages. The experimental diets were a control diet with soybean oil and a PUFA-deficient diet with tripalmitin (TG-16:0).

Results: FADS2-deficient mice fed a PUFA-deficient diet from birth resulted in a marked decrease in HUFAs and a dramatic accumulation of cholesterol in the liver. The degree of increase in hepatic cholesterol in FADS2-deficient mice fed a PUFA-deficient diet from birth was greater than those from adulthood. However, the expression of genes involved in cholesterol synthesis, transport, catabolism, and efflux was not increased in FADS2-deficient mice. In addition, the gene expression of the inflammatory cytokines such as TNF-α and IL-6 and the fibrosis markers such as Col1a1 and TGF-β were increased in the liver of FADS2-deficient mice. Furthermore, Azan and Sirius red staining results confirmed that fibrosis was increased in FADS2-deficient mice.

Conclusions: These results proposed that FADS2-mediated production of HUFAs in the liver had an inhibitory effect on the progression of hepatic steatosis and NASH.

Keywords: Fatty acid, Polyunsaturated fatty acid, Cholesterol, Hepatic steatosis, NASH

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-180
Coptidis Rhizoma and Evodiae Fructus Mixture Regulates Inflammation and Tight Junction Proteins in DGER rat

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Background and objectives: Gastroesophageal reflux disease (GERD) is a gastrointestinal disorder in which stomach contents reflux into the esophagus, causing complications such as mucosal damage. GERD accounts for more than 20% of the Western population and is a disease that is also increasing in incidence in Asian countries. This work aimed to assess the impact of Coptidis Rhizoma and Evodiae Fructus 1:4 mixture (CE) against esophageal mucosal injury with duodenogastroesophageal reflux esophagitis (DGRE).

Methods: After inducing DGRE through surgery, the group was separated (n=8) and the drug was administered for 2 weeks; normal rats (Normal), water-treated DGRE rats (Control), CE 100 mg/kg-treated DGRE rats (CE100), CE 200 mg/kg-treated DGRE rats (CE200). Thereafter, oxidative stress-related biomarkers were identified in serum and esophageal tissue, and the expressions of inflammatory cytokines in the lower esophageal sphincter and duodenum were analyzed through RT-PCR. Also, expressions of NADPH oxidase, inflammation-related proteins, and tight junction proteins were analyzed in esophageal tissue by western blotting.

Results: As a result, it was confirmed that ROS and MDA-related oxidative stress were decreased CE-treated. Also, in GERD-induced models, CE significantly reduced the inflammatory cytokine in the lower esophageal sphincter and duodenum and significantly regulated the expression of the NADPH oxidase in esophageal tissue. In addition, it not only modulated the MAPK and NF-κB pathways by modulating PI3K/Akt signaling but also significantly increased the expression of tight junction proteins.

Conclusions: Taken together, these findings indicate that CE alleviates inflammation by inhibiting oxidative stress and regulating PI3K/Akt signaling, thereby inhibiting the MAPK and NF-κB pathways. These results improve our understanding of the effect and the underlying mechanism of the CE in the management of DGRE.

Keywords: Coptidis Rhizoma, Evodiae Fructus, Duodenogastroesophageal reflux esophagitis, inflammation

Further Collaborators: This research was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. 2022R1A2B5B01002571).

PAB(T4)-181
Osteoarthritis Improvement Effect of *Pinus sylvestris* L.

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Background and objectives: *Pinus sylvestris* L. (PS) has the largest geographical distribution among pine species and is the most widely distributed conifer in the world. PS has anti-inflammatory and antioxidant properties, but its effect on osteoarthritis (OA) has not been studied. Therefore, in this study, the effect of PS on cartilage degradation and inflammatory response in osteoclasts and monosodium iodoacetate (MIA)-induced OA rats model was analyzed.

Methods: In this study, the effect of PS on Metal regulatory transcription factor 1 (MTF1) and Collagen T2 in osteoclasts was analyzed by performing immunohistochemistry (IHC). In addition, hind paw weight distribution ratio analysis of MIA-induced OA rats orally administered with PS (200 mg/kg) for 2 weeks was performed, and inflammation and collagen protein expression in articular cartilage tissues were analyzed by Western blot.

Results: As a result of osteoclasts analysis, it was confirmed that collagen-related factors MTF1 and Collagen T2 were increased during PS treatment. Furthermore, PS decreased the expression of nuclear factor kappa B (NF-κB), cyclooxygenase-2 (Cox-2), and tumor necrosis factor-alpha (TNFα) which are inflammation-related proteins increased by MIA in articular cartilage tissue. Also the expression of metalloproteinases (MMP)-2, 3, 13 increased by MIA was significantly reduced.

Conclusions: PS increased collagen-related factors in osteoclasts and inhibited inflammation-related factors and MMPs in MIA-induced OA rats to promote articular cartilage damage recovery. Therefore, PS could be a potential candidate for OA treatment.

Keywords: Pinus sylvestris L., Osteoarthritis, osteoclasts, monosodium iodoacetate

Further Collaborators: This study was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ015272012022)" Rural Development Administration, Republic of Korea

PAB(T4)-182
Metabolomics of cerebral cortex and cecal content in vitamin B_{12} deficiency-induced depression model rats

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Background and objectives: Some epidemiological studies indicate that vitamin B_{12} deficiency could be the risk of depression. However, their underlying mechanisms have not been well clarified. Some gut microbiota-derived metabolites affect brain function and most microbiota requires vitamin B_{12}. Therefore, it can be hypothesized that vitamin B_{12} affects gut microbiota-derived metabolites and consequently alters brain function. In the present study, we investigated metabolite levels of cerebral cortex and cecal content in vitamin B_{12} deficiency-induced depression model rats.

Methods: Twenty-eight male Wistar rats were divided into four groups and reared individually in metabolic cage. Control group fed the diet containing 50 μg/kg vitamin B_{12}, which meets the requirement based on the National Research Council. Other three groups were fed the diet containing vitamin B_{12} which were 50, 25, and 0 % of the control diet. All rats were fed for three weeks. Then, forced-swimming test were performed to confirm vitamin B_{12} deficiency-induced depressive-like behavior. After the euthanasia, cerebral cortex and cecal content were collected. Metabolite levels of these samples were analyzed by gas chromatography-tandem mass spectrometry-based metabolomics.

Results: Depressive-like behavior was increased by 0 % vitamin B_{12} diet compared with control. In cerebral cortex, of the 172 metabolites annotated, there was no metabolite related to both vitamin B_{12} intake and depressive-like behavior. In cecal content, of the 185 metabolites annotated, only asparagine was related to both vitamin B_{12} intake and depressive-like behavior, while acetic acid, butyric acid, and propionic acid were not related to them.

Conclusions: Relationships among vitamin B_{12}, gut microbiota, asparagine, and brain function should be investigated to clarify the mechanism of vitamin B_{12} deficiency-induced depression.

Keywords: Vitamin B12 deficiency, Depression, Cecal content, Metabolomics, Rat

PAB(T4)-183
Improvement Effect of *Cotoneaster mongolicus* Extract on MIA-Induced Osteoarthritis Animal Model

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Background and objectives: Osteoarthritis (OA) is a chronic degenerative disease of articular cartilage, the most common joint disease worldwide. OA affects the bone of joints and induces pro-inflammatory and anti-inflammatory pathway dysregulation, leading to pain. This study evaluated the anti-inflammatory effects of *Cotoneaster mongolicus* Pojark. extract (CM) *in vitro* and *in vivo*.

Methods: Analyzed the antioxidant and radical scavenging activities of CM. OA models were induced via intra-joint injection of monosodium iodoacetate (MIA) 50 μL with 80 mg/mL in rats. The drug concentrations were indomethacin 2 mg/kg and AF 200 mg/kg and were administered orally once a day for 2 weeks. Western blot was carried out for the changes of the associated protein expressions on articulation tissue.

Results: The total phenolic contents (125.42 ± 0.55 mg gallic acid equivalents/g) and total flavonoids (27.45 ± 0.17 mg quercetin equivalents/g) values were observed. The group administered with CM showed a significant reduction of changes in relative hind paw weight distribution. Moreover, NF-κB activation by MIA led to the release of pro-inflammatory markers whereas CM treatment markedly decreased such an increase.

Conclusions: As a result, CM has a therapeutic and protective effect on OA by suppression of inflammation. Therefore, CM could represent a potential and effective candidate for OA treatment.

Keywords: Cotoneaster mongolicus Pojark., Osteoarthritis, monosodium iodoacetate, inflammation

Further Collaborators: This study was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ015272012022)" Rural Development Administration, Republic of Korea.

PAB(T4)-184
Investigation of Refeeding syndrome-related substances for development preventive and treatment strategies

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Background and objectives: Refeeding syndrome (RFS) is the general term for a series of metabolic complications that develop when chronically malnourished patients are rapidly initiated on excessive nutritional therapy. Since details of the pathogenetic mechanisms of RFS are unknown, aggressive nutritional therapy should not be administered to malnourished individuals. Clarification of the metabolic status resulting from malnutrition prior to RFS might allow metabolic correction before nutritional therapy is initiated, and help to establish preventive and treatment strategies for metabolic correction before the onset of RFS. In this animal study, we investigated candidate preventive

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

and treatment substances for RFS using blood metabolome analysis prior to RFS.

Methods: We created a mild RFS animal model using rats that were fasted for 24-hours and refed with oral gavage using a 50% glucose solution and intraperitoneal administration of insulin. Identification of hypophosphatemia 24-hours after refeeding was used to confirm the development of mild RFS. 1. Metabolome analysis Blood samples were obtained from mild RFS model (fasted) and healthy rats (feed) for metabolome analysis to identify metabolic changes prior to the onset of RFS. Substances likely to have an association with the onset of RFS were evaluated, and candidate substances were extracted by %CV calculation and volcano plot analysis. 2.Prevention of hypophosphatemia by administration of candidate substances. In a separate experiment, mild RFS model rats were given the identified candidate substances prior to refeeding. Plasma phosphorus concentrations and other items related to RFS were measured and statistically analyzed before and after RFS.

Results: Blood metabolome analysis evaluated 711 substances. Of these, 160 substances were found to be lower in the mild RFS group before RFS than in the normal group. Statistical analysis revealed substances A, B and C as being associated with the onset of RFS. We are currently investigating the preventive effects of the candidate substances by administering them before refeeding.

Conclusions: These results suggest that any of the candidate substances prior to refeeding might prevent hypophosphatemia.

Keywords: Refeeding syndrome, blood metabolome analysis, hypophosphatemia, mild RFS animal model

PAB(T4)-185
Association between HIV and clinical outcomes of children aged 6-59 months diagnosed with growth failure: SAMAC sub-study

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Background and objectives: Growth failure in sub-Sahara Africa remains a leading cause of death among children under five years of age. The high incidence of HIV exacerbates the severity of infection and growth failure. This contributes to increased mortality and adds additional burden on already struggling health systems. The objective of the SAMAC sub-study is to determine the prevalence of HIV and to compare clinical outcomes between HIV positive and negative children in South Africa, Ghana and Botswana.

Methods: SAMAC is a multi-country, multi-hospital study and is based on a retrospective observational study design with a quantitative, descriptive-comparative approach. Medical records of children diagnosed with SAM in hospitals from three sub-Sahara African countries have been retrospectively reviewed between January 2013 and December 2018. Data were tested for normality with Shapiro-Wilks's test in SPSS. Pearson correlation coefficients were determined between HIV status and length of stay (LOS), rate of weight gain (RWG) (g/kg/day) and number of co-morbidities. Chi-square tests were done for HIV status and death, and discharge.

Results: Of the 533 participants included, 410 (77%) were HIV negative and 123 (23%) HIV positive. For HIV negative children LOS was 13.5 (± 8.4) days, RWG 7.8 (± 14.9) g/kg/day while HIV positive children had a LOS of 17.1 (± 12.6) days, RWG 5.0 (± 8.0) g/kg/day. 42 (10%) of the HIV negative children passed away while 31 (25.2%) of the HIV positive children passed away. There were significant differences ($P<0.05$) between HIV status and LOS, RWG, number of co-morbidities (especially TB and sepsis) and death.

Conclusions: Results indicated that the outcomes of growth failure are worse for children diagnosed with HIV. They stay longer in hospital, have a poorer growth rate with a higher mortality rate. This is mostly because they present with more serious co-morbidities such as TB and sepsis. The WHO guidelines currently recommend the same treatment regime for HIV positive and negative children. However, more strenuous treatment measures should be considered for those with HIV to ensure better clinical outcomes.

Keywords: Growth failure, HIV, Sub-Sahara Africa, Clinical outcomes, SAMAC

PAB(T4)-186
Uses of dietary supplements and risk of non-alcoholic fatty liver disease in hypertensive adults in South Korea

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Background and objectives: Non-alcoholic fatty liver disease (NAFLD) is characterized by increased fat accumulation in the liver and has emerged as one of the most prevalent, rising hepatic metabolic disorders, affecting approximately 40% hypertensive adults worldwide. Deregulation of micronutrient metabolisms, partly due to insufficient intake, is increasingly found to be associated with development of NAFLD. Use of dietary supplement (DS) may lower NAFLD risk, a significant cause of hepatic and cardiovascular mortality, potentially improving clinical complications of hypertension. Thus, we aimed to examine the potential clinical benefit and the specific behavior of DS uses and NAFLD risk in hypertensive adults.

Methods: We analyzed nationally representative, cross-sectional data from 4,954 hypertensive adults aged >19y with 1,574 NAFLD cases in the Korea National Health Examination Survey 2005 and 2007-2009. Current users of DS were identified via questionnaire and interviewed for frequency, duration, and types of DS uses. NAFLD was defined by having a hepatic

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

steatosis index>36. To investigate the associations between DS use and NAFLD risk, multivariable-adjusted odds ratios (MVORs) and 95% confidence intervals (CIs) were calculated using logistic regression.

Results: Approximately 26% subjects were current users of DS, of which 81%were using vitamin/mineral supplements. Current use of DS was not significantly associated with NAFLD risk. The multivariable-adjusted OR (95% CI) was 0.94 (0.73-1.20) comparing current users vs nonusers of DS. When we explored associations according to specific behaviors of DS use, we also observed no associations with increasing frequency of use (MVOR [95% CI]$_{\geqq 2 \text{ times/day vs. no use}}$: 1.13 [0.75-1.68]), duration (MVOR [95% CI]$_{\geqq 16 \text{ months vs no use}}$: 1.06 [0.62-1.81]), and concomitant use of DS (MVOR [95% CI] $_{\geqq 2 \text{ supplements vs. no use}}$: 1.06 [0.73-1.54]). (all $P_{\text{trend}} \geqq 0.80$) These results were not significantly different across stages of hypertension, use of hypertensive medication, age, gender, obesity, and status of smoking and alcohol consumption (all $P_{\text{interaction}} \geqq 0.06$).

Conclusions: The use of DS was not associated with NAFLD risk in hypertensive adults, regardless of specific behaviors of DS uses or population characteristics examined. Though prospective studies are warranted, our results do not support DS use as alternative clinical therapies to prevent NAFLD in hypertensive adults.

Keywords: Dietary supplements, Non-alcoholic fatty liver disease (NAFLD), Hypertensives adults, The Korea National Health and Nutrition Examination Survey

PAB(T4)-187
Relationship between γ-GTP and dietary choline intake

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Background and objectives: The relationship between choline intake and liver function is already known. Choline deficiency exacerbates liver function markers. For this reason, the US Food and Drug Administration established AI (adequate intake, 550 mg / day for men and 425 mg / day for women) as Essential Nutrition in 2001. The European Food Safety Authority also set AI (400 mg / day for adults) in 2016. In particular in the United States, data on the content of choline compounds in food is published on the website of the United States Department of Agriculture. However, in Japan, these are not listed in the 2020 Japanese Dietary Intake Standards and Food Composition Tables (8th edition). We previously reported to the Society that the intake of choline compounds by university students was chronically deficient at around 60% of the intake standard in the United States. In our study, we report the results of comprehensive medical examinations and the frequency of intake of choline compounds from the diet.

Methods: A questionnaire survey was conducted on the frequency of intake of foods rich in choline compounds for those who underwent a comprehensive medical examination at Hospital A. The subjects were 517 respondents (424 males and 93 females) who had agreed to the experiment. Correlation with the test data was verified. This time, the statistical analysis performed was the Tukey's HSD test method, using JMP (ver14.2).

Results: Among the liver function markers, the value of γ-GTP showed a strong correlation with the frequency of choline intake. There was a significant difference even after excluding the factors involved in liver function such as drinking, medical history (liver disease), BMI, age, and medication (drugs related to lipid metabolism).

Conclusions: Statistically significant difference in the frequency of intake of foods rich in choline compounds were observed between high and normal of γ-GTP level. It was suggested that a gradual inadequate intake of choline compounds over a long period of time may have a negative effect on liver function.

Keywords: Choline, γ-GTP

PAB(T4)-188
Associations of food insecurity with dietary inflammatory potential and risk of low muscle strength in Korean adults

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Background and objectives: Food insecurity is the disruption of food intake or eating patterns because of limited access for food and were associated with poor diet quality. Nutrient-poor diet disturbs lipids and glucose metabolism, aggravating oxidative stress and immune homeostasis. A higher inflammatory burden impairs skeletal muscle protein metabolism and muscle strength, which is recognized as a clinically important cardiometabolic marker associated with functional disability and early mortality. However, limited studies have examined the associations of food insecurity with dietary inflammatory potential and muscle strength. This study, thus, examined the associations between food insecurity and risk of low muscle strength and explored the potential role of diet as a mediator for the association.

Methods: Cross-sectional data from 9,595 adults aged >19y from the Korean National Health and Nutrition Examination Survey 2014-2015 were analyzed. The household food security status was assessed using an 18-item Food Security Survey Module. Dietary data were collected via 24-hr recalls assisted by trained interviewers. The pro-inflammatory potential of diet was estimated by calculating dietary inflammation index (DII). Low muscle strength was defined by having the maximally measured hand grip strength of dominant hand <28kg for men and <18kg for women. The associations of food insecurity with DII and risk of low muscle strength were examined using multivariable-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

adjusted linear regression and multivariable-adjusted logistic regression, respectively.

Results: Greater food insecurity was significantly associated with a higher DII. The multivariable-adjusted mean difference and 95% confidence intervals in DII, comparing "Moderate-to-severe" food insecurity group to "Food secure" group, was 0.31 (0.01-0.59) (P_{trend}: 0.02). "Moderate-to-severe" food insecurity group was also at greater risk of low muscle strength, compared to "Food secure" group. The multivariable-adjusted odds ratios and 95% confidence intervals was 2.08 (1.65-4.05) (P_{trend}: 0.03). These results were not heterogeneous by age, sex, physical activity, smoking, and obesity status.

Conclusions: In this nationally representative study of South Korea, food insecurity was associated with greater inflammatory diet potential and muscle weakness. Our results suggest diet-mediated alterations in pro-inflammatory conditions may exacerbate muscle strength, potentially increasing future risk of functional disability and cardiometabolic morbidity, among individuals at risk of food insecurity.

Keywords: Food insecurity, Dietary inflammatory potential, Low muscle strength , The Korea National Health and Nutrition Examination Survey

PAB(T4)-189
Impact of disease specific nutrition intervention on body composition and food intake in Head and Neck cancer patients

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Background and Objectives: Head and neck cancers (HNC) are one among the top leading cancer sites in India. HNC patients are susceptible to malnutrition due to swallowing problems which worsens with the advancing stage. Chemotherapy and radiotherapy further deteriorate the condition. The food intake reduces drastically ultimately leading to malnutrition. Although, food formulations are available in the Indian market, not all them are disease-specific catering to patient needs. Thus, this study aimed at developing a high energy high protein food formulation specific to HNC and assess the impact of nutrition intervention on body composition and food intake in clinically diagnosed HNC patients.

Methods: This prospective, open labelled, randomized, nutrition intervention study was conducted in Krishna Rajendra Hospital attached to Mysore Medical College and Research Institute from July 2017 to March 2019. Subjects aged above 18years, with histopathologically confirmed HNC undergoing treatment who showed willingness to participate were included in the study. Thirty-eight patients who gave consent for participation were randomized into two groups viz., Control group (n=20) which received nutrition counseling alone and, Intervention group (n=18) which received nutrition supplementation of the formulation and nutrition counseling. The effect of nutrition intervention was evaluated on food intake and body composition. The patients were followed up on 15th, 30th and 45th day.

Results: The trajectory of weight loss was higher in control group as compared to intervention group. A significant difference was observed in the indicators of muscle mass between the control and intervention group on all days of follow up (Day 15: p=0.037; Day 30: p=0.026; Day 45: p=0.014). The mean values of fat free mass, fat mass, body cell mass, protein and muscle mass were significantly higher in the intervention group than the control group after the 1st follow up. The intake of food was better in the Intervention group than the control group by the end of the follow up.

Conclusion: Nutrition intervention of the disease specific food formulation with the right consistency and composition can significantly improve food intake and body composition in head and neck cancer patients.

Keywords: Head and neck cancer, Nutrition intervention, Food formulations, Body composition, Malnutrition

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T4)-191
Quantification, dietary intake adequacy and circulating levels of vitamin B9, vitamin B12, betaine and choline levels, in Chilean women with polycystic ovary syndrome

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Background and objectives: Polycystic ovary syndrome (PCOS) is a prevalent and multifactorial endocrine disorder, characterized by reproductive and metabolic alterations. Existing data is not conclusive to determine differences in vitamin B9, vitamin B12, betaine, and choline levels in PCOS women. The objective of this study was to assess the dietary intake of vitamin B complex and cofactors in women with PCOS and their relationship with their metabolic profile in comparison to control women.

Methods: A total of 15 Chilean women with PCOS (P) without hormonal contraception and 19 control women (C) with a BMI between 18 and 35 kg/m² (18-34 y.o.) were included. Anthropometric measurements were carried out using standardized techniques and blood samples were obtained. A modified food frequency questionnaire for chilean foods was applied for the assessment of vitamin B9 (folic acid), vitamin B12, betaine and choline, and Recommended Daily Allowances (RDAs) were calculated. To evaluate metabolic status, lipid and biochemical profiles, vitamin B12, serum and red blood cells folate (RBC) were measured. Student's t-test or Mann Whitney

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

test were applied, and Pearson or Spearman correlations were performed (p<0.05 significant).

Results: PCOS women exhibited a significant increment in BMI (P:29.7 ± 6.6; C:22.6 ± 4.3 kg/m²; p>0.05), accompained by elevated insulin (P:13.7±7.4; C:8.6±5.9 uUI/mL;p>0.05). RBC (P:391.9±157.6; C: 311.6 ± 80.9 ng/mL), serum folate (P:12.7 ±3.8; C:11.0 ±2.9 ng/mL) and vitamin B12 (P:322.6±125.7; C:303.7±80.2 pg/mL) did not shown differences. RDA was calculated for vitamin B9 (P: 80%; C:47,7%), vitamin B12 (P: 46.6%; C:57.8) and adequate intake reference for choline (P: 0%; C:10.5%), and betaine (P:13%; C:0%), however, vitamin B9 intake and RDA were increased in PCOS women (p<0.05). Moreover, there was a positive correlation between insulin and BMI (r=0.612;p=0.000) RBC and serum folate (r=0.610;p=0.000); RBC and insulin (r=0.518;p=0.002).

Conclusions: The significant difference in vitamin B9 intake can be explained due to a national food-fortification program with folic acid in wheat flour. PCOS women were overweight and had a higher intake through bread consumption. PCOS and control women do not achieve the daily dietary recommendations for choline and betaine, which should be studied due to their impact on hepatic dysfunctions.

Keywords: PCOS, Folic Acid, Vitamin B12

PAB(T4)-192
The influence of niacin on pregnancy status and outcomes: A systematic review and meta-analysis

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Background and Objective: Maternal niacin intake may reduce the risk of birth defects and support fetal growth as seen in animal models. However, a comprehensive evaluation of the benefits of niacin on these outcomes has not been summarized across in-vitro, animal, and human studies. We performed an integrated systematic review and meta-analysis to compare pregnancy outcomes related to niacin intake or intervention in in-vitro, animal, and human studies.

Methods: We searched for human, animal, and in-vitro studies that assessed niacin intake or niacin intervention in pregnancy or pre-pregnancy, and related in-vitro outcomes, until June 2019 in Cochrane Library databases, PUBMED, SCOPUS, Proquest, and EBSCOhost (PROSPERO number: CRD42020140116 and CRD42020140111). The outcomes assessed were congenital malformations, fetal growth and loss, and related indicators. Two independent reviewers conducted the title and abstract screening and full-text eligibility assessment. The risk of bias and the quality of evidence were assessed according to the STROBE checklist, SYRCLE's risk of bias tool, and PRISMA checklist regarding the study type.

Results: After screening the title, abstract and duplicates, 166 out of 7,391 articles were selected, and eligibility after full text review included 12 in-vitro, 30 animal, and 12 human studies that were all observational, with no randomized controlled trials in humans. Higher maternal intake of niacin tended to be protective for birth defects in animal studies (pooled OR for random effect = 0.35; 95%CI 0.12–1.02, p=0.053), and intake or supplementation was protective against birth defects in human studies (random effect pooled OR 0.76, 95%CI 0.62–0.93; p=0.008). In animal models, maternal niacin intake also improved fetal growth (pooled standardized mean difference (SMD) = 2.7; 95%CI 2.45 – 2.96, p<0.001), tended to be protective for fetal death (random-effects pooled OR = 0.37; 95%CI 0.14–1.00, p=0.05), but did not affect breastmilk yield (pooled SMD = -0.07, 95%CI -0.25–0.09, p=0.38).

Conclusion: Maternal niacin intake provided a modest protective effect on birth defects in human observational studies consistent with animal models. Future clinical studies of niacin intake or supplementation on fetal outcomes are warranted to confirm these findings before establishing public health recommendations.

Keywords: Birth defect, fetal growth, niacin, meta-analysis, pregnancy

Conflict of Interest Disclosure: None

Further Collaborators: Lesley Braun, Vladimir Stajic

PAB(T4)-193
Eat-O'Clock: The Preliminary findings of the association between eating time with Body Mass Index (BMI) among Brunei Adults

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Background & Objectives: The obesity epidemic in Brunei has magnified the need to identify criteria for an optimal approach that promotes a healthy body weight. Chrononutrition is an emerging field in nutritional science that understands the role of meal timing with numerous evidence that have been linked to the improvement of weight status and health outcomes. However, to date, there is a paucity of research assessing the chrononutrition profile among Bruneian adults. This study aimed to determine the chrononutrition profile of Bruneian adults.

Methods: A cross-sectional study was conducted among 73 Brunei adults aged 18-59 years old. Subjects were recruited through voluntary participation throughout Brunei. Components of chrononutrition preferences and behaviors of breakfast

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

skipping, largest meal, evening eating, evening latency, nighttime eating, and eating window were assessed using an adapted questionnaire from the Chrononutrition Profile Questionnaire (CP-Q). Demographic and medical history was determined using a predesigned questionnaire, followed by anthropometric measurements of height, weight, and BMI.

Results: The participants included in the study consisted of 31 (42.5%) males and 42 (57.5%) females. The prevalence of BMI was 2.7% were normal weight, 36.5 % were overweight and 59.5% were obese. 66.3% skipped breakfast more than 5 days per week. Largest meal was lunch (70.3%), dinner (16.2%) and breakfast (12.2%) respectively. Consequently, 52.7% indulge in nighttime snacking after bedtime more than 5 days per week. The duration between the last eating before bed was 1 to 2 hours during workdays and free days were 38.1% and 35.9%, respectively. At least 32.4% wake up more than once a week to eat at night. Almost half practice more than 12 hours eating window during workdays and free days with 38.9% and 57.0%, respectively. There was a significant difference between breakfast skipping with BMI (r=0.222, p=0.050) and evening latency during workdays with BMI (p=0.028) respectively, whereby subjects who skip breakfast more than 5 days per week and shorter evening latency have higher BMI. However, there was no association between largest meal, evening eating, evening latency on free days, night time eating, and eating window with BMI.

Conclusions: These findings suggest that breakfast skipping and shorter evening latency on workdays were found to influence BMI. Further studies to explore the role of breakfast skipping and evening latency on workdays vs free days Further studies to explore the role of longitudinal effect of meal timing long could be included to understand the role of chrononutrition to BMI and disease prevention among Brunei adults.

Keywords: Chrononutrition, meal timing, body mass index, adults

Conflict of Interest Disclosure: NA

Further Collaborators: NA

PAB(T4)-194
Effect of a novel supplementary porridge on the nutritional status of infants and young children diagnosed with moderate acute malnutrition in Uganda: a cluster randomised control trial

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Background and Objective: Moderate acute malnutrition (MAM) and anaemia are prevalent among infants and young children (IYC) in Uganda. A lack of consensus regarding the most effective strategy for managing MAM among IYC resulted in the present study comparing the effect of malted sorghum-based porridge (MSBP) (an active malt, extruded maize and soy sorghum supplementary porridge developed for the purpose of the present study) as an intervention versus an extruded maize and soy micronutrient fortified blend (CSB+) as a control and current standard care. Outcome measures were anthropometric status and haemoglobin levels.

Methods: The study comprised a double-blind cluster randomised control trial with eight to 10 conveniently sampled consenting mother–IYC pairs per cluster who were randomly assigned to the intervention (n = 110) or control (n = 110) for 3 months. Weekly anthropometric measurements were taken. Haemoglobin levels were measured at baseline and end line. Mean length-for-age, weight-for-age, length-for-weight and mean haemoglobin levels of the treatment and control groups were compared using an independent t-test. The Z-test was used to compare proportions of the outcome indicators between the treatment and control groups.

Results: Difference in mean weight-for-age Z-scores in the treatment group improved compared to control (P= 0.010). The change in mean haemoglobin levels was lower in the treatment versus the control group (P= 0.010). The proportion of IYC recovering from MAM between treatment and control did not differ significantly (P=0.055).

Conclusions: Recovery rates after supplementation with MSBP versus CSB+ resulted in similar weight-for-length and haemoglobin levels. Therefore, MSBP has the potential for being scaled up in the management of IYC with MAM in Uganda.

Keywords: Child nutrition status, Heamoglobin, Leng-for-weight, Moderate acute malnutrition, Supplementary porridge

Conflict of Interest Disclosure: The Authors declare that they have no conflict of interest

Further Collaborators: None

PAB(T4)-195
Effects of cardiorespiratory fitness on appetite-related hormones in response to a standardised meal in young men

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Background and objectives: Maximal oxygen uptake (VO2max) is an important determinant of aerobic capacity and it has been shown to be a strong predictor of all-cause and disease-specific mortality. Appetite-related hormones (acylated ghrelin; an appetite-stimulating hormone, peptide YY (PYY); an appetite-suppressing hormone) are important physiological factors involved in short-term appetite regulation. It has been suggested that habitual physical activity influences homeostatic appetite control by enhancing post-meal satiety, mediating energy intake to match energy expenditure in response to hunger and satiety signals. However, it remains unclear whether individuals with different levels of cardiorespiratory fitness differ in the meal

responses of appetite-related hormones. Thus, the purpose of the present study was to examine the effects of cardiorespiratory fitness on appetite-related hormones in response to a standardised meal.

Methods: Thirty young healthy males [23 ±2 years old (mean ±standard deviation)] underwent a 1.5-h laboratory-based experiment. They were divided into two groups according to median VO2max: above median (the high VO2max group (15 participants; [55.6 ±4.6 ml/kg/min])) and below median (the low VO 2max group (15 participants; [45.5 ±4.3 ml/kg/min])) evaluated by maximal exercise testing. Participants consumed a standardised meal at 1000 h. Venous blood samples (circulating concentrations of acylated ghrelin and PYY) and subjective appetite (hunger and fullness) were collected prior to 1000, 1030, 1100 and 1130 h.

Results: There were no differences in fasting circulating concentrations of acylated ghrelin, PYY or subjective appetite between groups (all for $p>0.05$). Regardless of VO2max level, acylated ghrelin was suppressed and PYY was elevated after the meal (all for $p<0.001$). Subjective feelings of hunger was suppressed and fullness was elevated after the meal regardless of VO2max level (all for $p<0.001$). There were no differences in the patterns of circulating concentrations of acylated ghrelin, PYY or subjective appetite over the course of the entire experiment between groups (all for $p>0.05$).

Conclusions: The present study demonstrates that the post-meal responses of appetite-related hormones were similar among healthy young men with different levels of cardiorespiratory fitness.

Keywords: Cardiorespiratory fitness, maximal oxygen uptake, appetite, appetite-related hormones, young men

PAB(T4)-196
Improvement of energy and protein intake after dietetic intervention among COVID-19 patients in a rehabilitation and convalescent hospital

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Background and objectives: Malnutrition is frequently seen in hospitalized COVID-19 patients, and studies suggested malnutrition rate among COVID-19 patients ranged from 27.5% to 82.6%. Poor nutrition status often contributes to lower rehabilitation potential and poorer clinical outcome of the COVID-19 rehabilitation patients. The aims of this study are to investigate the nutrition status, energy and protein intake and the adequacy before and after dietetic intervention among COVID-19 patients in a rehabilitation hospital.

Methods: Total 93 COVID-19 patients admitted to the Shatin Hospital for rehabilitation purpose during the admission period from February to April 2022, were recruited for the analysis. Electronic dietetics records of patients who have seen a dietitian for nutrition support were retrieved. Information such as gender, age, weight, BMI and malnutrition risk were collected. Energy intake and protein intake were compared at the baseline and the follow-up dietetic assessment. Patients who has no nutrition intake at the follow-up assessment were excluded. The estimated energy and protein requirement for this patient group were used to calculate the energy and protein adequacy in percentage, and compared between baseline and post-dietetic intervention.

Results: There were 41 males and 52 females, the mean age was 81.4±12.3 years old, mean weight 48.4±11.3kg and BMI 18.9±3.7kg/m². There were 54% patient was underweight (BMI<18.5 kg/m²) at admission. Among this group, the overall prevalence of malnutrition risk was 94.6% (medium risk:66.9%; high risk:24.7%). The energy intake at baseline was 715±422kcal and increased significantly to 1021±387kcal after follow-up intervention ($p<0.001$). The baseline protein intake was 32±18g, and increased significantly to 47±18g protein afterwards ($p<0.001$). The percentage of energy and protein adequacy were improved from 53.2% and 57.2% during admission to 74.7% and 83.3% after intervention respectively, which both meeting the most part of their daily energy and protein requirement ($p<0.001$).

Conclusions: This review suggested high prevalence of malnutrition among COVID-19 hospitalized rehabilitation patients, with high percentage of underweight patient admitted to hospital. Their energy and protein intake greatly improved after dietetic intervention, with meeting most of the energy and protein requirement. Improvement of nutrition intake benefits on better clinical outcome and recovery at rehabilitation period.

Keywords: COVID-19, rehabilitation , malnutrition , energy , protein

PAB(T4)-197
The role of ultra-processed food intake and development of dyslipidemia and obesity in middle-aged and older adults: A longitudinal community-based study

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Background: Impact of ultra-processed foods (UPF) consumption is an emerging issue on nutrition and health. How to prevent and manage obesity and dyslipidemia better is still the topic that the publics concerned. The consumption of UPF has increased steadily in South Korea. However, the long-term effect of UPF consumption on the development of obesity or dyslipidemia in South Korea is unknown. Besides, compared to other well-known diet quality index, whether UPF consumption is a useful tool to assessed diet quality need to be confirmed.

Objective: We aimed to investigate the association between UPF intake and the risk of obesity or dyslipidemia and to evaluate the validity of UPF consumption in assessing the diet quality.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: We studied 17,310 adults aged ≧ 40 years in the Health Examinee cohort study from 38 community sites of South Korea. UPF consumption was classified by NOVA system. After an average five-year follow-up, we examined the incidence of obesity or dyslipidemia and investigated the association between UPF consumption and risk for incident obesity or dyslipidemia. To evaluate UPF validity in assessing the diet quality, we made a comparison using alternative Mediterranean Diet (AMED) Score which developed for Korean based on Mediterranean Diet Score.

Results: The incidence of dyslipidemia was 35.41% and 43.04% in men and women, respectively, and that of obesity was 8.28% and 7.39% in men and women, respectively. There was a positive association between the UPF consumption and the risk for dyslipidemia development: the Q4 group was almost 20% higher than the Q1 group (men, adjusted HR=1.209 [95% CI 1.039 – 1.407], women, adjusted HR=1.195 [95% CI 1.096 – 1.303]. For obesity, only women demonstrated a significant positive association (model 3, HR=1.360 [95% CI 1.072 – 1.725]). There was no significant association between other NOVA food group consumption and dyslipidemia was found. After calculating AMED scores, only UPF consumption showed a significant negative association with AMED score (*p* value<0001).

Conclusion: Higher UPF intakes were associated with increased incidence of dyslipidemia and obesity. Furthermore, UPF consumption showed the statistically significant negative association with AMED score indicating a poor diet quality.

Keywords: Ultra-processed food, dyslipidemia, obesity, NOVA system, Mediterranean Diet Score

Conflict of Interest Disclosure: This research was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2022R1F1A1074279) and was supported by the Basic Science Research Program through the NRF funded by the Ministry of Education (NRF-2018R1A6A1A03025159). MSIT: Ministry of Science and ICT.

All authors report no conflict of interest.

PAB(T4)-198
Effect of kimchi consumption on obesity by BMI and abdominal obesity in Korean adults

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Background and objectives: The prevention of obesity is a significant public health goal because obesity is associated with hyperlipidemia, metabolic syndrome, and type 2 diabetes. Previous animal studies show probiotic lactic acid bacteria derived from kimchi affected anti-obesity. However, only a few epidemiological studies have investigated the association between kimchi consumption and obesity. Therefore, this study aimed to examine the relationship between kimchi consumption and obesity in Korean adults.

Methods: Data was collected from 38 general hospitals and health examination centers from 2004 to 2013. A total of 119,224 participants (37,499 in men and 81,725 in women) aged 40 to 69 years were available for this cross-sectional study. Obese by body mass index (BMI, kg/m^2) was defined as 25≦BMI (class Ⅰ obese 25≦BMI<30 and class Ⅱ obese 30≦BMI), and abdominal obesity was defined as 90≦waist circumference (WC) in men and 85≦WC in women. The validated FFQ was used to assess kimchi consumption. Total kimchi included cabbage kimchi, radish kimchi, watery kimchi, and other kimchi. A multivariable logistic regression analysis model was used to estimate the odds ratio (OR) and 95% confidence interval (CI) of obesity according to kimchi consumption.

Results: The prevalence of obesity was 28.2% (35.9% in men and 24.6% in women) in this study. After controlling for potential confounders, women with higher cabbage kimchi consumption (≧150g/day) had 8% lower odds of class Ⅰ obese (OR: 0.922; 95% CI: 0.857-0.992) and 23% lower odds of class Ⅱ obese (OR: 0.774; 95% CI: 0.633-0.945) as compared with consumed<50g/day. In both men and women, participants who consumed radish kimchi≧median (25.0g/day in men, and 10.7g/day in women) were inversely associated with lower odds of abdominal obesity (OR: 0.915; 95% CI: 0.840-0.997 in men, and OR: 0.912; 95% CI: 0.863-0.963 in women) compared to non-consumers.

Conclusions: Consumption of total kimchi was not clearly shown to be associated with obesity and abdominal obesity. However, cabbage kimchi was associated with lower obesity prevalence in women, and radish kimchi was associated with a lower prevalence of abdominal obesity in both men and women.

Keywords: Kimchi consumption, obesity, abdominal obesity, HEXA study

Conflict of Interest Disclosure: This research was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2022R1F1A1074279). MSIT: Ministry of Science and ICT.

This research was supported by grants from the World Institute of Kimchi (KE2201-1) funded by the Ministry of Science and ICT, Republic of Korea.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-199
Physical activity status and its associated factors among hypertensive patients in 3 counties of Guizhou Province

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Background and objective: To investigate the situation and influencing factors with hypertensive patients' physical activity in 3 counties of Guizhou Province.

Methods: With multi-stage random sampling, 2230 hypertensive patients with basic public health management and drug treatment were selected from residents of three counties and asked to fill in questionnaires on the assessment of physical activity and relevant factors.

Results: The proportion of physical activity meets standards was 37.0%. The results of logistic regression analysis showed that hypertensive patients with following characteristics were more likely to have physical activity behaviors: Living in a city or town (odds ratio [*OR*]=4.722, confidence interval [95% *CI*]:3.522~6.332), grade school culture degree(*OR*=1.587, 95% *CI*:1.247~2.019), Junior high school and above education level(*OR*=1.914, 95% *CI*:1.434~2.556), Non-farmers (*OR*=1.909, 95% *CI*:1.448~2.516), Central obesity (*OR*=1.284, 95% *CI*:1.009~1.632). The hypertensive patients with following characteristics were less likely to have physical activity behaviors: Han nationality (*OR*=0.606, 95% *CI*:0.486~0.755), The course of disease ranged from 5 years to 10 years (*OR*=0.714, 95% *CI*:0.587~0.869), Course of disease over 10 years (*OR*=0.603, 95% *CI*:0.420~0.865).

Conclusion: The physical activity in patients with hypertension in 3 counties of Guizhou Province is insufficient. Residence, education level, occupation, central obesity, nationality, course of disease are related to the physical activity.

Keywords: Hypertension, physical activity, influence factors, basic public health

PAB(T4)-200
Effects of Intermittent High-Dose Vitamin D Supplementation on Risk of Falls and Fractures: A Systematic Review and Meta-analysis

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Background: Randomized controlled trials (RCTs) have reported controversial findings regarding the associations between intermittent high-dose vitamin D supplementation and the risk of falls and fractures in adults. This study aimed to investigate those associations by using a systematic review and meta-analysis.

Methods: We searched PubMed, EMBASE, and Cochrane Library from inception to May 25, 2022. Data were extracted for a random-effects meta-analysis to calculate a pooled relative risk (RR) with a 95% confidence interval (CI).

Results: Out of 527 articles, a total of 16 RCTs were included in the final analysis. In the meta-analysis of all the included RCTs, intermittent high-dose vitamin D supplementation showed no significant benefit in the prevention of falls or fractures (RR, 1.02 [95% CI, 0.92-1.13]; I2 = 53.8%; n = 16). In the subgroup meta-analysis by methodological quality assessed based on the Jadad scale, intermittent high-dose vitamin D supplementation showed an increased risk of falls and fractures (RR, 1.10 [95% CI 1.00-1.20]; I2 = 27.2%; n = 10) in high-quality RCTs. Publication bias was not observed in the Egger's test (P for bias = 0.35).

Conclusions: In this meta-analysis of RCTs, intermittent high-dose vitamin D supplementation had no preventive effect in the risk of falls and fractures and even showed a harmful effect in the high-quality trials. Therefore, an intermittent high-dose regimen of vitamin D supplements for the purpose of the prevention of falls and fractures in adults should be discouraged.

Keywords: Vitamin D, falls, fractures, randomized controlled trials, meta-analysis

Conflict of Interest Disclosure: None.

Further Collaborators: None.

PAB(T4)-201
Diets poor or rich in unprocessed beef have similar effects on body weight homeostasis and body composition after rapid weight loss

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Background and objectives: The physiological effects of consuming different amounts of unprocessed red meat during weight loss maintenance are not known. We aimed to evaluate the effects of diets with small or large amounts of lean beef, consumed after successful weight loss, on body weight homeostasis and body composition.

Methods: In this randomized controlled trial, 108 adults with BMI 28-40 kg/m^2 (45 men/63 women) underwent an 8-week very-low-calorie diet (VLCD) phase, and those who lost at least 8% body weight (n=80) continued to a 12-week ad libitum diet phase while consuming a moderate-protein diet with 25 g beef/day (B25, n=45) or a high-protein diet with 150 g beef/day (B150, n=35).

Results: Among the 69 subjects who completed the entire study, weight loss during the VLCD phase averaged 12.5 kg (11.5, 13.5) in B25 and 13.1 kg (12.1, 14.1) in B150 (means with 95% confidence intervals). During the ad libitum diet phase, body weight decreased further in both B25 and B150 groups by -1.3 kg

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(-2.4, -0.3) and by -1.1 kg (-2.2, -0.0), respectively; fat mass decreased by -2.4 kg (-3.2, -1.6) and by -3.0 kg (-3.9, -2.2), respectively, whereas lean mass increased by 1.1 kg (0.6, 1.7) and by 1.9 kg (1.3, 2.5), respectively. There were no significant differences between the two diet groups in these outcomes (all P>0.05). Intention-to-treat analysis with multiple imputation for dropouts (20 from B150 and 19 from B25) yielded similar results.

Conclusions: Diets with little or a lot of unprocessed red meat (lean beef) consumed ad libitum during the first 3 months after clinically significant rapid weight loss have similar effects on body weight and body composition.

Keywords: Obesity, weight maintenance, fat mass, lean mass, red meat

Conflict of Interest Disclosure: Dr. Geiker has received funding from various organizations to conduct studies relevant to the role of meat in the diet. The other authors report no conflicts of interest relevant to this abstract.

PAB(T4)-202
Therapeutic Approaches to Malnutrition Enteropathy (TAME): a randomised controlled trial in children with severe acute malnutrition in Zambia and Zimbabwe

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Background: Severe Acute Malnutrition (SAM) carries high mortality when complicated by infection or metabolic derangements, which require inpatient management. As intestinal dysfunction (diarrhoea, microbial translocation, malabsorption) is a prominent feature of complicated SAM we set out to evaluate four novel interventions for intestinal dysfunction in children with complicated SAM.

Methods: Multi-arm, phase II, non-blinded randomised controlled trial in two hospitals in Lusaka, Zambia, and Harare, Zimbabwe. All children received inpatient standard care following WHO guidelines. Children were randomised to 14 days of i) oral or nasogastric bovine colostrum three times daily, ii) N-acetyl glucosamine three times daily, iii) budesonide three times daily (then tapered), iv) subcutaneous teduglutide once daily, or v) standard care only. The primary endpoint was a composite of faecal biomarkers (myeloperoxidase, neopterin and α_1-antitrypsin). Secondary endpoints were biomarkers of mucosal damage, inflammation, and microbial translocation; and clinical recovery, anthropometry, adverse events and mortality. A subgroup in Lusaka additionally underwent endoscopy for small intestinal biopsy. α for hypothesis testing was pre-specified at 0.1.

Results: Between May 2020 and April 2021, 125 children were randomised, 3 died, 3 withdrew, and 119 (95%) contributed endpoint data. The faecal biomarker score (mean at baseline 1.87) was reduced in the teduglutide group by 0.89 (95%CI -0.06, 1.85) compared with the standard care group (*P*=0.07 by ANCOVA). Teduglutide also led to a significant increase in crypt depth in mucosal biopsies compared to standard care (median 197mm (IQR 149,221) versus 151mm (IQR 136,162); P=0.02 across all groups). Budesonide reduced plasma C-reactive protein (CRP; mean reduction 5.2mg/L (95%CI 0.0, 10.5); P=0.05) and CD163 (mean reduction 405 ng/mL (95%CI 8,803); P=0.05) while colostrum and N-acetyl glucosamine had effects only on CRP (reductions 5.9mg/L (95%CI 0.6, 11; P=0.03) and 4.8mg/L (95%CI 0.3,10; P=0.07) respectively). Diarrhoea was reduced by 2.2 days (95%CI 0.9, 3.5: P=0.001) in the N-acetyl glucosamine group. Adverse Events were not significantly different between treatment arms.

Conclusions: All interventions were safe. Teduglutide led to significant reductions in markers of malnutrition enteropathy, and budesonide reduced systemic inflammation. Larger trials are warranted to establish clinical efficacy, optimal timing and duration of intervention during nutritional rehabilitation.

Keywords: Severe Acute Malnutrition, Teduglutide, Budesonide, N-acetyl glucosamine, Colostrum

Conflict of Interest Disclosure: R.J.P. was previously an external consultant to Colostrum UK which provided the bovine colostrum used in these studies. RJP has also been an external consultant to Sterling Technology (USA) and an employee of Pantheryx Inc (USA) who produce and distribute BC. There was no bovine colostrum company involvement in the production of this article or editing of its content.

PAB(T4)-203
Optimising nutritional status in patients with chronic respiratory diseases through pulmonary rehabilitation to improve disease outcomes

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Background and objectives: Chronic respiratory diseases (CRD) that include chronic obstructive pulmonary disease (COPD) and asthma with its associated fatigue, malnutrition, loss of muscle mass, reduced muscle strength and endurance and the resulting psychological effects adversely affects patient's health-related quality of life. Pulmonary rehabilitation (PR) includes assessment of nutrition status and interventions that will improve residual functionality in patients with CRD. The objectives of the study was to assess the feasibility of PR and improvement in functionality of CRD patients.

Methods: A pre-post quasi-experimental study assessed the feasibility of peripheral center based PR and its outcomes, offered at outreach centers close to their homes, promoted by peer volunteers and assisted by health professionals on 30

participants with CRD. After the written consent and optimising the medical treatment, the participants were assessed for their socio-demographic, medical and treatment history, endurance level, muscle strength, activities of daily living (ADL), haemoglobin level and BMI. For those with anaemia and abnormal BMI were assessed for dietary intake using 24 hours recall by the nutritionist. The components of PR included diet counselling, treatment of anaemia, changing physical activity habits, handgrip strength exercises, lower extremity strength training, breathing exercises to improve nutritional status, upper limb, lower limb and inspiratory muscle strength. Their rehabilitation activities were monitored by the trained peer volunteers.

Results: The median age of participants was 57.5(IQR=47.5-70.25);10% of them had mild to severe undernutrition, 37% had overweight and 13% were obese; 33.3% had anaemia. At the end of 8 weeks of training, aerobic capacity and endurance assessed by 6-minute walk test and endurance testing cycling time, hand-grip strength and percentage distribution of ADL improved significantly($p<0.01$); prevalence of anaemia reduced to 16.4% and BMI remained the same at the end of 6 months.

Conclusions: Pulmonary rehabilitation that paid special attention to nutritional status and muscle strengthening exercises can contribute significantly to reduce residual disability and improve functionality in patients with CRD

Keywords: Pulmonary rehabilitation, nutrition counseling, Chronic respiratory diseases, endurance training, muscle strengthening

Conflict of Interest Disclosure: The author(s) declare(s) that there is no conflict of interest.

Further Collaborators: RESPIRE Collaborators.

PAB(T4)-204
The Methods, Effectiveness, and Challenges of Nutrition Intervention Based on Digital Health

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Background and objectives: Nutrition is one of the most critical factors in health management. Digital health provides new opportunities for nutrition education, dietary assessment, and management through online information delivery. With wide application, high convenience, and intense interaction, digital health-based dietary interventions are gradually playing a vital role in nutrition intervention. However, there is a lack of adequate review and evaluation. As a result, we tried to review the development of digital health intervention in nutrition.

Methods: We reviewed previous nutritional intervention studies using digital health methods through a literature review. Peer-reviewed published articles and grey literatures areliterature were all included. The quality of the literature was assessed according to guidelines on digital health by the CONSORT (Consolidated Standards of Reporting Trials) list.

Results: Digital nutritional interventions use mobile devices and self-reported data to collect participants' dietary status, rely on databases and algorithms to evaluate personal data, utilize online systems to transfer online information to provide nutrition and lifestyle education and to engage in discussion. It changes individual behavior and health outcomes by combining the above methods. In terms of the participants, interventions mainly focus on patients and young people. They always choose blank or usual care as a control. With the development, the number of participants is growing from only a few people to a sufficient scale. Meanwhile, the outcome indicators are not just usually compliance or behavioral indicators but disease-related outcome indicators, such as changes in blood biochemistry and imaging. Studies have demonstrated the feasibility of digital health intervention in nutrition. However, research design, intervention implementation, and scientific evaluation also have much room for improvement. Information security and health inequalities in this area should be given more attention. Therefore, it is necessary to carry out high-level scientific, normative and feasible dietary intervention research focus on more health problem and wider population.

Conclusions: Digital health has promising applications in nutrition and lifestyle interventions, but the quality of research needs to be strengthened, and the scope of its application should be promoted.

Keywords: Digital Health, Nutrition Intervention, Dietary Intervention, Review

PAB(T4)-205
Changes in colon luminal environment induced mitochondrial dysfunction of epithelial cells in obese mice

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Background and objectives: Obesity and overweight are characterized by a systemic low-grade inflammation that has been associated with disturbances of intestinal homeostasis and dysbiosis. Energy metabolism, in particular through mitochondria, plays a central role in intestinal epithelial homeostasis. In addition, dietary modulations of the luminal environment may impact mitochondrial function. The aim of this study was to evaluate whether consumption of an obesogenic diet, also called western diet (WD), alters mitochondrial function of colonic epithelial cells (CEC) in mice.

Methods: Male C57Bl/6J were fed a control diet (CTRL, 10% kcal from fat) or a WD (58% kcal from fat and drink water supplemented with fructose and sucrose at 42 g/L). After 22 weeks, CEC were isolated to assess mitochondrial function by Seahorse® technology while colonic content was collected to characterize microbiota, through 16S DNA analysis, and

intestinal metabolites, via nuclear magnetic resonance and a methylene blue-based assay for sulfides.

Results: WD mice developed obesity associated with hepatic steatosis and systemic endotoxemia (LPS-BP: 535.8±38.5 vs 668.7±39.7 ng/mL, P<0.05). Analysis of CEC bioenergetics revealed a mitochondrial dysfunction marked by decreased basal (61.0±10.5 vs 31.2±5.5 pmol O_2/min/DNA, P<0.05) and maximal respirations (87.5±15.0 vs 44.1±9.9 pmol O_2/min/DNA, P<0.05) as well as lower respiration linked to ATP production (35.4±8.0 vs 18.8±2.9 pmol O_2/min/DNA, P<0.05). Yet, WD consumption did not alter gene and protein expressions of mitochondrial respiration chain complexes, and mitochondrial dynamics was not affected. The colonic metabolome analysis showed that consumption of a WD induced an increase in bile acid concentrations in WD mice, associated with an increase in the abundance of Desulfovibrionaceae and especially Bilophila, a known H_2S producer. Besides, sulfide concentration was markedly increased in colon content of WD mice (5.9±1.7 vs 31.74±10.5 µM/mg of content, P<0.01).

Conclusions: These results suggest that changes in the luminal environment induced by WD consumption disrupted the mitochondrial respiratory chain, potentially through deleterious effects of H_2S. This mitochondrial dysfunction could promote the loss of intestinal homeostasis or even increase susceptibility to intestinal inflammation.

Keywords: Obesity, Colon, Mitochondria, Microbiota, Metabolism

PAB(T4)-206
Effect of consumption of fish rich in n-3 polyunsaturated fatty acids on treatment response in patients with rheumatoid arthritis

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Background and objectives: Rheumatoid arthritis (RA) is a systemic autoimmune disease caused by an inflammatory process triggered by environmental factors in genetically predisposed individuals. The use of targeted therapies has transformed the treatment of RA and resulted in a good clinical response, but not in all the patients. Consumption of fish rich in n-3 polyunsaturated fatty acids (PUFA) has been reported to have a favourable effect on RA incidence and disease activity. However, the effect of n-3 PUFA-rich fish on the response to targeted therapies in RA patients has not been elucidated. This study aimed to investigate the relationship between n-3 PUFA-rich fish consumption and response to targeted therapies in RA patients.

Methods: The study is a cross-sectional study of RA patients receiving targeted therapies at Hokkaido University Hospital. On the day of study entry, patients were invited to complete a brief self-administered dietary history questionnaire and a detailed fish intake frequency questionnaire (DFFQ). Fatty and non-fatty fish intake scores were calculated using a mathematical formula based on the intake of each of the fish included in the DFFQ. Alcohol consumption, smoking, educational level and employment status were also recorded, and disease activity was assessed by rheumatologists. Demographic, clinical/laboratory data were retrospectively extracted from medical records. Patients were classified as responders or non-responders using the disease activity score, DAS28-ESR.

Results: A total of 102 RA patients, 84 women, median age of 66 yrs (Q1-3, 56-73) were included. Ninety-one patients were on biologic agents and 11 on Janus kinase inhibitors. Seventy-six patients were responders to treatment. Ninety-eight % of patients reported having consumed fish rich in n-3 PUFA in the last month, 49% less than once a week, and 49% at least once a week. Patients who responded to treatment had higher n-3 PUFA-rich fish intake scores compared to those in the non-responder group (Mann-Whitney U test, p=0.02). Multivariate logistic regression analysis showed that higher n-3 PUFA-rich fish intake scores were associated with treatment response (p=0.03, OR: 1.12, 95% CI: 1.02-1.25).

Conclusion: Consumption of n-3 PUFA-rich fish is associated with treatment response in RA patients receiving targeted therapies.

Keywords: Rheumatoid arthritis, fish consumption, targeted therapy, n-3 PUFA, DAS28

PAB(T4)-207
Additive effect of common obesity-related SNP variants in admixed Brazilian population: 2015 ISA-Nutrition study.

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Background and objectives: Large-scale genome-wide association studies (GWAS) identified loci associated with obesity, however, most evidence refers to populations of European or Asian ancestry. Considering the importance of diversity and the participation of multi-ethnic groups in GWAS, we aimed to identify loci associated with obesity in admixed Brazilian population from Sao Paulo city.

Methods: The analyses included 841 free-living individuals aged 12 years or more of the cross-sectional population-based Health Survey of Sao Paulo with Focus on Nutrition (2015 ISA-Nutrition). Obesity was defined according to BMI cutoffs. Genotyping was obtained from blood using Axiom PMR Array, resulting in 731,392 high-performing markers, after quality control pruning. Population structure and global ancestry were accessed through principal component analysis, comparing data

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DOI: 10.1159/000530786

with 1000 Genomes Project phase 3 (1KGP). A list of 1,500 markers previously associated with obesity-related traits in other GWAS reported by NHGRI-EBI GWAS Catalog was selected to perform initial evaluation of possible markers associated with obesity in ISA-Nutrition sample. We performed a logistic regression model with obesity as dependent variable, adjusted by sex, age group, interaction sex-age group, marital status, plasma C-reactive protein levels, presence of diabetes, hypertension, dyslipidemia, and the two first principal components of global ancestry, assuming an additive effect of the markers.

Results: The population included 49.7% of women, 29.7% adolescents, 34.5% adults and 35.8% older adults (mean age=47y; min.=12y; max=93y) with 22.8% prevalence of obesity. The mean ancestry proportion was: 53% European, 23% African, 23% Native American, and 1% Asian (East and South). There were 14 obesity-related candidate SNP that reached significance (P<0.01). Eleven SNP were previously associated with obesity-related traits in a study evaluating Hispanic children from Houston, TX, USA. The rs1993709 (OR-AG/AA=1.77, OR-GG/AA=3.15) and rs1514177 (OR-CG/CC=0.616, OR-GG/CC= 0.379) were previously associated with obesity and BMI in other studies with European populations, the rs259067 (OR-TG/GG= 0.618, OR-TT/GG= 0.382) was associated with obesity in East Asians, and the rs1421085 in gene FTO (OR-CT/TT=0.558, OR-CC/TT= 0.312) was associated with obesity and obesity-related traits in studies with diverse populations.

Conclusions: The findings provide an entry point to characterize common obesity loci that may be ancestry-specific in the Brazilian population.

Keywords: Obesity, GWAS, Genetics, Admixed population, Complex diseases

Conflict of Interest Disclosure: None.

PAB(T4)-208
Differences of different energy calculation formulas and the relationship between actual intake and clinical outcomes in critical patients with ventilator

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Background and objectives: If the critical ill patients with ventilator fail to provide adequate nutritional intake in time, it would induce the loss of lean body mass and prolong the recovery time. Excessive caloric intake will increase consumption of oxygen and production of carbon dioxide. It also leads to difficult weaning from ventilator. However, the current clinical ways of evaluating caloric requirement were not consistent. It is quite important for how to conveniently and accurately assess the caloric requirement of critically ill patients with ventilator. The purposes of this study were to assess the differences between current caloric supply and the calculation result of Penn State equation (PSU), and to investigate the relationship between intakes and patients' clinical outcomes.

Methods: This was a retrospectively observational study. The medical records of patients with mechanical ventilation at the surgical intensive care unit (SICU) were reviewed. We collected patients' demographic characteristics, anthropometric measurements, ICU length of stay, ventilator days, and 28-day survival situation.

Results: Caloric requirements calculated using the PSU for ICU patients were not significantly different from the simple weight-based equations of ASPEN recommended. The average number of days for patients to reach their caloric goals, intakes up to 70% of the requirement, was only 1.5±1.6 days in the second to seventh day after admission to the ICU. Correlation analysis showed that caloric intake was not significantly associated with clinical outcomes. On the other hand, protein intake was only significantly correlated with the ventilator days. For every 1-gram increase in protein intake, the ventilator days decreased by 0.27±0.13 days (p<0.05).Although there was no statistically significant correlation between protein intake and ICU length of stay or 28-day survival rate, there was a trend for a decrease in ICU length of stay with each additional 1 gram of protein (-0.28±0.14 days, p=0.055).

Conclusions: The estimation of caloric needs by simple weight-based equations for ICU patients was similar to the PSU. Within one week of ICU admission, increasing protein intake might have a trend to improve clinical outcomes in the setting of calorie deficit.

Keywords: Ventilated critical patient, energy calculated formula, protein intake, clinical outcome

PAB(T4)-209
Impact of dietary counselling on dietary and plasma advanced glycated end products levels: A randomized controlled trial

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Background and objectives: Advanced glycated end products (AGEs) are a complex group of compounds that are developed by non-enzymatic reactions between reducing sugar and amino acids in proteins and other macromolecules. They can be obtained exogenously from diet or formed endogenously within the body and greater levels found in older adults in particular. Previous research revealed that dietary and plasma AGEs levels are significantly associated with age-related diseases risk. Dietary counselling is one of an effective dietary strategy to attenuate an age-related disease risk while its effect on the modulation of dietary and plasma AGEs levels has not been well investigated. Therefore, this study aimed to assess the impact of dietary counselling on dietary and plasma AGEs levels in older adults through a randomized controlled trial (RCT).

Methods: This was a 12-week, parallel design, RCT where 39 older women (aged above 60 y) in Singapore were randomized

in which the intervention group received 12-week dietary counselling while the control group did not receive dietary counselling. The counselling covered various topics on food proportioning, food label reading, cooking methods and several age-related diseases conditions. N-carboxymethyl-lysine (CML) is a well characterized and most prevalent AGEs and dietary CML level was estimated using previous published databases and plasma CML level was analyzed using a high performance liquid chromatography.

Results: There was no significant difference and change in dietary CML levels between intervention (week 0: 5.6 mg/d ± 2.6; week 12: 5.5 mg/d ± 3.0) and control group (week 0: 5.8 mg/d ± 2.8; week 12: 5.8 mg/d ± 2.9). However, control group increased plasma CML level (week 0: 184.3 ng/ml ± 19; week 12: 292.1 ng/ml ± 27) while intervention group decreased plasma CML level (week 0: 166.3 ng/ml ± 17; week 12: 120.0 ng/ml ± 15) after intervention and there was a significant difference in plasma CML levels between groups at week 12.

Conclusions: The provision of dietary counselling may be a viable nutritional strategy in lowering age-related disease risk by modulating plasma AGEs levels.

Keywords: Dietary counselling, Advanced glycated end products, Older adults, Age-related disease

Conflict of Interest Disclosure: NIL

Further Collaborators: NIL

PAB(T4)-210
The relationship between the distinction of nutritional supply to critically ill patients in different divisions and clinical outcomes

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Background and objectives: The strategy of nutritional intervention was correlated with clinical outcomes in critically ill patients. Previous studies had found that not all critical patients improved the outcome after increasing caloric intake. In the acute phase of critical ill, the critical patients produced energy by catabolism to supply the energy expenditure. The debt of energy was the amount of energy supply. However, the difference of catabolism was existed between the different diseases. The purpose of this study was to retrospectively investigate whether the pattern of calorie and protein supply associated with clinical outcomes between medical and surgical intensive care unit.

Methods: This was a retrospectively observational study. The medical records of patients who had been admitted to an intensive care unit for more than 72 hours were reviewed. The inclusion criteria of this study for patients included those who were 20 years or older, and those who had been admitted to intensive care unit for more than 72 hours, the exclusion criteria were that they received neither enteral nor parenteral nutrition. Their demographic characteristics, anthropometric measurements, nutrient-related data form enteral, parenteral, or intravenous, laboratory data and several clinical outcomes were collected.

Results: There was no significant difference in baseline information and biochemical profile between the two groups except that white blood cells in medical patients was significantly higher than that in surgical patients (14.8±8.3 vs. 11.2±5.5 x10^3 cells/mm^3, p=0.001). There were no significant associations of caloric or protein intake with clinical outcomes either in all patients or when patients were classified as medical or surgical patients. Disease severity, by contrast, significantly associated with clinical outcomes. The patients were further divided into two groups according to disease severity, Apache Ⅱ score 14 points. It was found that the calorie intake of patients with a score of ≦14 might correlated with the length of stay (LOS), but which still no statistically significant difference (p=0.057).

Conclusions: Disease severity was still the most important factor to influence clinical outcomes. The correlation between caloric intake and LOS seemed to have a trend in patients with lower disease severity.

Keywords: Critically ill patient, Divisions type of critically ill patient, clinical outcomes

PAB(T4)-211
Effect of daily supplementation with spirulina fortified cereals on the body composition of people living with HIV/AIDS in Chad

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Background: Nutritional status of people living with HIV/AIDS (PLHA) in low- and middle-income countries remains a major determinant of mortality, poor response to antiretroviral therapy (ART), and higher dropout rates. Protein supplementation is a promising strategy for restoring fat-free mass (FFM) and reducing weight loss in PLHIV. Our objective was to assess, among PLHA receiving ART, the effectiveness of supplementation with spirulina-fortified or unfortified millet flour on changes in weight, and in FFM and fat mass (FM).

Methods: In an interventional randomized controlled trial, 345 adults living with HIV/AIDS, who attended the Hôpital du jour, N'Djamena and just started ART were enrolled. Participants were assigned randomly to receive one of the nutritional treatments for a period of six months: 1) standard care only, ART and nutritional counseling (Control); 2) daily 500 g of unfortified millet flour and standard care (Millet); and 3) daily 500 g of spirulina-fortified millet flour and standard care (Spirulina). At baseline and endline, weight and height were measured. Body composition was assessed using the deuterium dilution method.

Analysis of co-variance was used to compare the difference between groups. Differences were considered significant at $p<0.05$.

Results: 345 adults (33.2 ± 7.7 years of age) were enrolled and 295 completed the study. At baseline, 16.5% of participants were underweight (body weight index, BMI<18.5 kg/m^2<) and 79.4% had low to severely-low CD4. Weight increased in all groups (mean ± SD; 3.41 ± 4.17 kg). Weight gain was significantly higher in spirulina (4.74 ± 0.41 kg) than in millet (3.63 ± 0.44 kg) and control (1.91 ± 0.36 kg) groups ($p<0.0001$). Change in FFM was significantly greater in spirulina (6.02 ± 0.69 kg) compared to millet (3.06 ± 0.52 kg) and control (1.07 ± 0.84 kg). Proportion of FM (%FM) was lowest in the spirulina group (25.1% vs. 27.6% and 28.0% in control and millet groups respectively, $p=0.003$).

Conclusion: In food insecure settings, spirulina-fortified cereal flour increased weight with a body composition favoring FFM and a lower %FM. Further analyses will assess the effects on the immune response to ART.

Keywords: Supplementation, Spirulina, Fat mass, Fat-free mass, HIV

Conflict of Interest Disclosure: Alain Nahaskida was granted a PhD scholarship for 18 months by the International Atomic Energy Agency (IAEA, Vienna). The IAEA funded partially the data collection of this study.

PAB(T4)-212
Association of dietary patterns with overweight/obesity in school-aged children in Hebei

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Objective: To summarize the dietary patterns, analyze the current situation of obesity, and explore the relationship between dietary patterns and overweight/obesity in children aged 7-16 years in Hebei.

Methods: A total of 1085 children aged from 7 to 16 years old were enrolled in Hebei. Data on socio-demographic, dietary and lifestyle factors were collected by questionnaires. The dietary patterns of children were identified by factor analysis, and the population differences of overweight/obesity status of children were analyzed by chi-square test. The height and weight, waist circumference and hip circumference of children were measured on site to calculate body mass index (BMI), and then determine their overweight/obesity status. Logistic regression models were performed to evaluate the association between dietary patterns and children overweight/obesity.

Results: A total of 574 boys (52.90%) and 511 girls (47.10%) were included in this study. The overweight rate of children was 11.22%, the obesity rate was 8.02%, and the combined rate of overweight and obesity was 17.60%. Three dietary patterns of children in Hebei were identified: pattern 1 mainly includes beverages, ice cream, and western fast food; pattern 2 was beans, whole grains, dairy products as the main food; and pattern 3 was consisted of vegetables and fruits. After adjusting for gender, age, parental education, household income, energy intake, energy expenditure from moderate to high intensity physical activity, and pubertal development level, it was found that the higher pattern 2 score, the lower risk of developing overweight and obesity in children (OR: 0.58, 95% CI: 0.32-0.91); pattern 1 and pattern 3 may not be associated with overweight and obesity.

Conclusion: Children in Hebei are seriously overweight and obese. Thus, increasing food intake of legumes, whole grains, dairy products may be useful for improving overweight and obesity.

Keywords: Dietary patterns, Obesity, Nutrition, School-children

PAB(T4)-213
Effect of intake order of staple food, main dish, and side dish on postprandial blood glucose level in healthy young individuals

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Background and objectives: Recently, dietary methods that consider the intake order of dishes have attracted attention in suppressing postprandial hyperglycemia and weight gain. On the other hand, the triangular eating (TE) method, in which staple foods, main dishes, and side dishes are eaten alternatively has long been established in Japan. In this study, we comprehensively investigated the effects of the intake order of staple food, main dish, and side dish on the increase in postprandial blood glucose levels. We also compared the effects of TE on postprandial blood glucose levels.

Methods: Seven healthy women participated in this study. The order of intake of the test meals was as follows: RMV: staple food (boiled rice), main dish (ginger grilled pork meat), and side dish (vegetable salad), RVM, MRV, MVR, VRM, and VMR. Regarding TE, the participants were randomly and alternately allowed to eat meat, vegetables, and rice in small amounts. Participants visited the laboratory at 9:00 on seven different days and consumed one of the seven test meals. Following blood collection, participants consumed one of the seven test meals, and the start of the test meal intake was considered 0 min. Blood was then collected again at 30, 60, 90, and 120 min to measure glucose levels. The area under the blood glucose concentration−time curve (AUC) between 0 and 120 min was calculated using the trapezoidal rule.

Results: The postprandial blood glucose level at 30 min of meal VRM increased similarly to that of meals RMV and RVM. At 120 min, postprandial glucose level was significantly higher in

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

meal VRM than in meals RMV, RVM, MRV, and TE. However, meal VMR, another vegetable-first meal, suppressed postprandial blood glucose levels and the AUC compared with meal VRM. The AUC was lower in meals MVR and MRV than in other meals, and the effect was stronger with meal MVR. In contrast, meal TE had little suppressing effect on postprandial blood glucose levels and the AUC.

Conclusion: These results suggest that the suppressing effect of postprandial hyperglycemia was greater for dietary protein than for dietary fiber. However, further detailed research may be needed.

Keywords: Intake order, rice, meat, vegetables, blood glucose

PAB(T4)-214
Effects of weight loss intervention program between diabetes referral patients and volunteers at a community hospital

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Background and Objectives: Lifestyle modifications can help weight control. Weight loss can also help delay pre-diabetes, and help diabetics control sugar. The aim of this study was to compare the effects of weight loss programs between referring diabetic patients and volunteers at outpatient clinics of a community hospital.

Methods: The subjects were adults with BMI ≧ 24 and referred from diabetes clinics or voluntarily enrolled. Weight loss intervention programs were held in the summer of 2018 and 2019, and each program contained four 50-min sessions of nutrition education and 50-min exercise courses. A total of 27 cases were participated, including 17 diabetic patients and 10 volunteers. Demographic data, height, weight, BMI and health information were collected before and after intervention.

Results: The average age was 51.7 years old and there was no significant difference in gender and age distribution between two groups. The average weights of the diabetes referral group before and after intervention were 81.5 and 80.1kg (-1.5kg; -1.8%). The average weight changes of the volunteers decreased from 77.1 to 73.9 kg (-3.3kg; -4.3%). There was no significant difference of weight loss between two groups. Linear regression analysis indicated that gender and age were not correlated to weight changes. All participants with higher body mass index before intervention had significant weight loss after intervention (p<0.01).

Conclusions: Although the weight loss program at community hospitals is beneficial to those with heavier weight, it is not effective for involuntary diabetes referral cases. Due to the small sample size and short-term intervention, it is difficult to receive obviously differences on weight changes. More study with large scale is needed through group intervention in the future.

Keywords: Weight loss program, lifestyle modifications, voluntarily enrolled

PAB(T4)-215
Personalized Nutrition Management and Information Provision for Autistic Children : Exploratory Clinical Research for Innovative Digital Platform

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Background and Objectives: Considering personalized nutrition, people have different physiological and environmental complexities, and their dietary habits are different, so even if they eat the same food, their responses are very different. Previous researches have shown that children with autism spectrum disorder (ASD) have eating problems and therefore the quality and variety of diet they eat are generally lower than those of their normally developing peers. We developed a web/app-based personalized nutrition prediction model for ASD children and their caregivers, and performed the exploratory clinical basic research to investigate its effectiveness.

Methods: For application of personalized nutrition for children with ASD, the selection of biomarkers and nutrients to apply were reviewed in depth. Twenty children aged 3-5 years based on Autism Diagnostic Observation Schedule and K-Childhood Autism Rating Scale-2 and their 20 caregivers were participated in the study. Social Communication Questionnaire, K-Vineland-II, K-Parenting Stress Index-4 were observed for autism symptoms, and blood, genetics, and intestinal microbiota were examined for autistic children. Their caregivers recorded daily breakfast, lunch, dinner, snacks, nutritional supplements, etc. of autistic children for 6 weeks using the developed web/app tool. The first two weeks of the dietary data of children with ASD was observed followed by the four weeks, based on dietary, blood, and intestinal microbiome data, providing personalized nutrition counseling at weekly intervals to the caregivers. At the end of the study, the autism symptom, blood nutrients, and intestinal microbiome of the children with ASD were re-examined, and the caregiver satisfaction on the personalized nutritional prediction model was evaluated.

Results: By using the personalized nutrition prediction model, it was confirmed whether it could help improve diet diversity, intake of major nutrients for neurobehavioral development, diversity of intestinal microbiome, blood levels of nutrients, and autistic symptoms. Satisfaction with personalized nutrition management and information provision model was also investigated for caregivers.

Conclusions: Individualized nutritional interventions and appropriate supplementation using an innovative personalized nutrition digital platform can play an important role in ASD management.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keywords: Autism, Personalized Nutrition, digital platform, biomarker, neurobehavioral development

PAB(T4)-216
Validation of a dietary pattern approach with risk of obesity in Korean adults: the Korea National Health and Nutrition Examination Survey

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Background and Objectives: Few studies have examined the multifaceted aspects of dietary patterns for their effects on obesity. The objective of this study is to identify the dietary patterns associated with the risk of obesity among Korean adults using data from the Korean National Health and Nutrition Examination Survey (KNHANES, 2015-2018) and for validation data (KNHANES, 2019-2020), a nationally representative cross-sectional survey.

Methods: A total of 20,500 adults (8,744 men and 11,756 women) aged 19-64 years participated in the Korea National Health and Nutrition Examination Survey (KNHANES) 2015-2018. A 24-h recalls for nutrient intakes was collected and dietary patterns were derived using Reduced Rank Regression (RRR). In this study, BMI and waist circumference were selected as the intermediate response variables based on the associations with obesity. Obesity in Korean adults is defined as body mass index ≧25 kg/m^2, and as waist circumference ≧90 cm for men and ≧85 cm for women. Associations were assessed by logistic regression with adjustment for confounding factors.

Results: All of energy and nutrient intakes of dietary pattern, characterized by high intakes of refined white rice, kimchi and salted vegetables, and low intakes of fruits, poultrys, eggs, milk and dairy products, and nuts significantly increased as the from quintile one to quintile five. After controlling for potential confounders, total subjects in the highest quintile of patten 1 scores had a greater risk of obesity (odds ratio = 1.30; 95% confidence interval = 1.15-1.48; p<0.01), in comparison to those from the lowest quintile. Moreover, verifying validity was confirmed by applying the same dietary pattern score to the validation dataset consisting of other subjects. Significant associations were observed for either men or women.

Conclusions: Adherence to a dietary pattern characterized high intakes of refined white rice, kimchi and salted vegetables, and low intakes of fruits, poultrys, eggs, milk and dairy products, and nuts is associated with a higher risk of obesity.

Keywords: Dietary pattern, Korean adults, Obesity, Reduced rank regression, Odds ratio

PAB(T4)-217
Evaluation of CKD Patients' Satisfaction in CKD Comprehensive Care Clinic, Fort Nawamintharachini Hospital

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Background and Objectives: Comprehensive care in chronic kidney disease (CKD) patients can prevent renal function decline and delay the progression of the disease, our team developed CKD clinic program with multidisciplinary team including nutritionist, physiotherapist, doctor, nurse, and pharmacist, which was for educational purposes not only medication but also diet and exercise intervention. Our program was empowering patients to get the information for lifestyle modification. One key to successful treatment is patients' satisfaction which contributes to patients' engagement, thus we aimed to study the CKD patients' satisfaction who attended in our clinic.

Methods: A cross-sectional study was conducted in 34 CKD patients (stage 3a-4) who attended in our clinic from December 2021- August 2022. The satisfaction was scored and described into four aspects: overall of our program, service, health professional staffs and other comment. We evaluated satisfaction level and also measured renal function before and after attending in this clinic.

Results: Most of CKD patients were male (76.5%), CKD stage 3a (58.5%), with mean age 67 years old. 50% of CKD patients felt very satisfied, 30% neutral, and 20% extremely satisfied. Most of patients thought that our clinic was useful and wanted to attend continuously. The average of GFR improved after attending to clinic 3.2 ml/min/1.73m^2.

Conclusions: CKD patients satisfied to attend in multidisciplinary care CKD clinic which contributed more knowledge and prevented renal function decline.

Keywords: Chronic kidney disease clinic, Satisfaction score, Multidisciplinary team care, Lifestyle modification, Nutrition

Conflict of Interest Disclosure: -

Further Collaborators: -

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-218

Association of diet quality and risk of overall hypertension and three hypertension phenotypes-isolated systolic hypertension, isolated diastolic hypertension, and systolic-diastolic hypertension

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Background and Objectives: Increasing evidence indicates that hypertension, which causes approximately half of cardiovascular deaths, is a heterogeneous disease. Isolated systolic hypertension (ISH), isolated diastolic hypertension (IDH), or systolic and diastolic hypertension (SDH) are major subtypes of hypertension reported to have varied population distribution, risk factors, incidence, and cardiovascular sequelae. However, little is known whether diet, a well-known risk factor for hypertension, has differential influences on ISH, IDH, and SDH risk. We evaluated associations between diet quality and the risk of overall hypertension and ISH, IDH, and SDH.

Methods: We analyzed a nationally representative cross-sectional data of 34,855 Korean adults aged ≧19 in the Korea National Health and Nutrition Examination Survey (2014–2020). Korean diet quality was evaluated using the Korean Healthy Eating Index (KHEI) based on a 24-hour dietary recall. Following the 2017 American College of Cardiology/American Heart Association and 2018 Korean Society of Hypertension guidelines, participants were defined to have hypertension (systolic blood pressure (SBP) ≧ 130 mmHg or diastolic blood pressure (DBP)≧80 mmHg or using hypertensive drugs), ISH (SBP ≧ 130 mmHg and DBP<80 mmHg), IDH (SBP<130 mmHg and DBP ≧ 80 mmHg), and SDH (SBP ≧ 130 mmHg and DBP ≧ 80 mmHg). Multivariate logistic regression analysis was used to examine the association between KHEI and risk of hypertension and its subtypes.

Results: A greater KHEI was significantly associated with lower risk of overall hypertension (P-trend: <0.001). Multivariable-adjusted odds ratios (ORs) (95% confidence intervals [CIs]) comparing in the highest to the lowest quintiles of KHEI were 0.79 (0.72-0.86). This inverse association was consistently observed irrespective of hypertension subtypes defined as ISH, IDH, and SDH. The multivariable-adjusted OR (95% CIs) comparing extreme quintiles of KHEI were 0.84 (0.71-0.99) for ISH, 0.85 (0.76-0.96) for IDH, and 0.74 (0.66-0.85) for SDH (all P-trend: ≦ 0.03).

Conclusions: In this first analyses of diet quality and hypertension subtypes in Korean, those adhering to dietary guideline for Koreans were at lower risk of hypertension regardless of its phenotype, which may reflect pleiotropic etiologic involvement of healthy diet preventing hypertension. Large-scale, prospective study is required to replicate these findings.

Keywords: Korean Healthy Eating Index, Hypertension, Isolated systolic hypertension, Isolated diastolic hypertension, Systolic and diastolic hypertension

PAB(T4)-219

High sucrose diet-induced abnormal lipid metabolism in mice is related to the dysbiosis of gut microbiota

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Background and Objectives: The metabolic syndrome has become a problem all over the world. As a cause of metabolic syndrome, a high sucrose diet has received highly attention recently. In human, a high sucrose diet is thought to cause fatty liver and obesity. In rats, a high sucrose diet caused fatty liver and hyperlipidemia but did not cause obesity. However, a high sucrose diet caused obesity in mice. In order to find out the differences among species, we examined the effect of high sucrose diet in mice. Based on previous research on rats, high sucrose diet-induced metabolic disorder was related to the changed gut microbiome. In this research, the relationship between cecum microbiome and high sucrose induced abnormal lipid metabolism in mice was also examined.

Methods: First, to determine the phenotypes of different mouse strains, C57BL/6N, C3H/HeJ, DBA2, ICR and ddY mice were fed with a high sucrose diet for 28 days. Next, to determine the relationship between high sucrose diet induced abnormal lipid metabolism and the change in gut microbiome, C57BL/6N mice were fed with a high sucrose diet and 4 types of antibiotics for 28 days. Liver was collected to analyze the quantity of mRNA by real-time PCR. The content of cecum was collected for the analysis of gut microbiome.

Results: A high sucrose diet increased body weight and liver weight in C57BL/6N mice, and induced fatty liver in C57BL/6N, C3H/HeJ, DBA2 and ICR mice, but did not induce hyperlipidemia in all strains of mice. A high sucrose diet changed the composition of gut microbiome and short chain fatty acids in C57BL/6N mice. Antibiotics treatment suppressed the fatty liver, body weight gain and fatty acids synthesis induced by a high sucrose diet.

Conclusion: A high sucrose diet caused obesity and fatty liver in some strains of mice, but did not cause hyperlipidemia. Excess sucrose induced abnormal lipid metabolism through the change in gut microbiome in both rats and mice. It is possible that abnormal lipid metabolism induced by a high sucrose diet in human is also related to the dysbiosis of gut microbiome.

Keywords: Metabolic syndrome, High sucrose diet, Fatty liver, Gut microbiome

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-220
Anemia and body mass index are associated with the prognosis of Guillain-Barré syndrome: an observational study in Bangladesh

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Background and Objectives: Host nutritional status has effects on immune response that are implicated in the pathogenesis of autoimmune diseases including Guillain-Barré syndrome (GBS). We examined the association of nutritional and socio-economic status with disease progression and outcome of GBS in Bangladesh.

Methods: A total of 147 GBS patients were enrolled in this observational study in Bangladesh. Socio-demographic information was collected using a standard questionnaire and baseline anthropometric measurement such as body mass index (BMI), waist circumference (WC), hip circumference (HC) and mid-upper arm circumference (MUAC) were measured. GBS severity and prognosis were assessed by GBS disability score (GBS-DS). Routine blood parameters were measured using automated analyser. Logistic regression was performed to see the association between nutritional status, socio-economic status, disease severity and outcome.

Results: The median (IQR) age of the patients was 35 (20) years with male predominance (70%). The median (IQR) of BMI, WC, HC and MUAC were 23.3 (5.8), 82.0 cm (18), 88.5 cm (16) and 26.0 cm (4.9), respectively. More than 70% patients belonged to poor and middle-wealth socio-economic quintiles. Majority (98%) of the households used improved water source, mostly from own tube well (48%), followed by piped water supply (36%). Almost 90% GBS patients used good sanitation facilities. Around 44% GBS patients was underweight (BMI<18.5) and overweight/obese (BMI>25 to 29.9/ 30-39.9), which was associated with increasing disease severity (OR: 0.324, 95% CI: 0.10-1.0, *P*: 0.048). Increased haemoglobin was associated with lower risk of developing severe disease (OR: 0.61, 95% CI: 0.23-0.90, *P*: 0.01) and significantly associated with good outcome (GBS-DS<3) at 4 weeks (OR: 1.46, 95% CI: 1.06-1.63 *P*: 0.02) and 26 weeks (OR: 1.37, 95% CI: 1.07-1.8, *P*: 0.03). Decreased WBC (OR: 0.76, 95% CI: 0.68-0.89, *P*<0.05) was associated with long-term prognosis.

Conclusion: Anemia and underweight/overweight/obese patients with GBS are significantly associated with increased risk of disease severity and clinical prognosis. However, further large-scale studies are required to confirm the findings.

Keywords: Anemia, Body mass index, Guillain-Barré syndrome, Bangladesh

Conflict of Interest Disclosure: No conflict of interest.

Further Collaborators: Not applicable

PAB(T4)-221
The association between Metabolic Syndrome and Chinese Healthy Eating Index in a community population of Shanghai

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Objective: To research the association between Metabolic Syndrome (MS) and Chinese Healthy Eating Index (CHEI), and identify the benefit or adverse diets of MS in a community population of Shanghai.

Methods: According to the included and excluded criteria, the data of 4 856 subjects from a community of Shanghai was collected by interview, and calculated the total CHEI score and its component score based on the frequency of food consumption. Physical examination and blood biochemical tests were used to diagnose the MS. The logistic regression model was used to analyze the relationship between MS or relative indexes and the total CHEI score or its component score.

Results: The study showed the overall prevalence of MS was 24.71%. There were significant differences in aspects of age, BMI, waist circumference, fasting blood glucose, triglycerides, total cholesterol, systolic blood pressure, diastolic blood pressure, glycated hemoglobin, high-density lipoprotein and energy intake between MS group and controls (*P*<0.05). After adjusting for potential confounders, the higher score of total CHEI score, the lower risk of central obesity, increased diastolic blood pressure, increased glycated hemoglobin, hyperglycemic and MS (*P*<0.05). The increased components score of potatoes, milk, beans, dark vegetables, fruits, oil and sodium reduced risks of obesity, hypertension, hyperglycemia, dyslipidemia and MS, respectively (*P*<0.05).

Conclusion: The healthy diet quality (CHEI score more than 80) and increased intake of specific dietary components (potatoes, milk, beans, dark vegetables, fruits) were reducing the risk of MS effectively.

Keywords: Metabolic Syndrome, Chinese Healthy Eating Index, cross-sectional study, the frequency of food consumption, diet

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T4)-222
Nutrition intervention for bariatric surgery patients by using social network service

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Background: In Taiwan, the prevalence of obesity is rapidly increasing, and now it rise to 23.9%. Bariatric surgery is the most effective treatment to morbid obesity. The nutrition status will change due to the surgery, patients should have access to a comprehensive nutrition and dietetic assessment. The knowledge about food choices will influence their long term nutrition status.

Method: After nutrition consultation clinic to teach bariatric surgery patients how to eat, 997 patients will come back to nutrition consultation clinic for every 3 months, 626 patients after the nutrition consultation clinic, will added social network service to trace their diet, patients will measured body composition every 3 months and one year. Data analysis use SPSS 22. Result: Female 1035 and male 588, age 36.1±9.7 years old, Body mass index 40.4±6.6 %, body fat before intervention is 52.4±18 kg, one year body fat is 27.2±10.6 kg; body fat after intervention is 53.1±13.6, one year body fat is 26.2±10.4 kg

Conclusion: Nutrition is important for patients after bariatric surgery, use social network service could have a better intervention, help patient become heathier.

Keywords: Nutrition intervention, Bariatric surgery, social network service

PAB(T4)-223
The association between screen time and physical activity on mental health among preschool children: a cross-sectional design from Gui Zhou province during COVID-19 pandemic

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Background and objectives: Preschool children are in the period of forming healthy personality, their mental health (MH) and behavioral health are the most critical factor of psychological development. This study aimed to investigate the relationship of physical activity (PA) and screen time (ST) with preschooler's MH outcomes.

Methods: The study was a cross-sectional design. 19015 parents/carers completed an online questionnaire on behalf of their child (aged 3-7 years old) in Gui Zhou province, China during 2019-2021. The parent version of the Strengths and Difficulties Questionnaire (SDQ) was selected to measured children's mental health. PA patterns were divided as three groups: total activity, Moderate to Vigorous Physical Activity (MVPA) and outdoor activity. PA time was divided as four categories, which were demonstrated as below 1 hour per day, 1-2 hour per day and beyond 2 hours per day. Similarly, ST time was performed to below 2 hours per day, 2-4 hours per day and beyond 4 hour per day. Multiple logistic regression analysis examined the association between PA and ST with MH.

Results: For five subscales of SDQ score, the emotional symptoms were the most common problems in children's mental health compared other subscales, inversely, Peer problems were the least problematic subscale. Multiple logistic regression analysis showed ST time more than 2 hours was associated with higher scores on SDQ, and preschooler who spent beyond 4 hours per day on screen time have higher risk of mental disorder than screen time on 2-4 hours per day. Higher level of total physical activity were associated with lower scores on SDQ. Moreover, only residence, CHSQ, annul average per capital income and whether affected by COVID-19 in other collected information have effect on SDQ score.

Conclusions: Both ST and PA time were independently associated with children's mental health, and less ST and more PA time are good for MT.

Keywords: Mental health, physical activity, screen time, Strengths and Difficulties Questionnaire, preschool children

PAB(T5)-1
Associations between Perceptions of Attractive Body, BMI, and eating habits among Young Women with and without Children in Japan

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Background and objectives: Thinness among young women is one of the critical health issues in Japan. To avoid unnecessary dieting, a proper perception of body image relative to Body Mass Index (BMI) is important. Furthermore, satisfaction with one's body image may also lead to higher self-esteem and remove the motivation for unnecessary dieting. This study aimed to determine the associations between perceptions of attractive body, BMI, dietary attitudes, and eating habits among young women with and without children in Japan.

Methods: We conducted a cross-sectional online survey in September 2021. The participants were 433 women aged 20–39 years in Japan. Perceptions of an attractive body was measured using the Physical Self-Perception Profile (Japanese version), and categorized into three groups based on distribution. The physical and cognitive variables were BMI, body shape perception, and misperception. Eating attitudes were measured using the Dietary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Consciousness Scale, which analyzes the importance and precedence of diet. Eating habits were measured by frequency of intake of meals that included dishes with grains, fish or meat, and vegetables and the frequency of consumption of 18 food groups. The association between the three groups by attractive body score and the total score of recommended food groups intake was examined using analysis of covariance adjusted for age and financial and time constraints.

Results: Women with higher attractive body scores, with or without children, had significantly higher percentages of "thinness" (with children: 38.3%, without children: 41.1%) than lower attractive body score groups. Women with children had higher attractive body scores, regarded diets as important, and showed higher intake frequency of meals that included grains, fish or meat, and vegetables. In addition, women with higher attractive body scores had a higher total score (adjusted mean: 34.2±1.9) of recommended food groups intake (middle: 32.5±1.7, lower: 28.2±1.7).

Conclusions: These results indicate that women, with or without children, who had higher attractive body scores were underweight, but eating better. In the future, we would like to clarify not only the frequency, but also the amount of food intake among women who have higher attractive body scores.

Keywords: Perceptions of attractive body, BMI, eating habits, young women, Japan

PAB(T5)-2
Is maternal perception of their own body size and that of their children related to nutritional status?

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Background and objectives: The Greater Accra Region has one of the highest prevalence of overweight or obesity in Ghana. A mother's bias about her own weight and that of her children may influence dietary practices and subsequent nutritional status. This study aimed to investigate whether maternal perception of their own body size and that of their children is related to their actual body sizes.

Methods: This cross-sectional study involved 229 mothers (≧18 years) of children 6-59 months old selected from creches in the Accra Metropolitan Area. The weight and height of mothers and children were measured, mothers' BMI and children's BMI z-scores were calculated, and appropriate WHO cut-offs were used to categorize the mothers and children as underweight, normal weight, overweight, or obese. Body size perception was evaluated according to Bush's body size images and a validated 7-image toddler silhouette. The agreement between maternal perceived and actual body sizes was assessed using kappa statistics. Logistic regression was used to determine the predictors of overweight/obesity among mothers and children.

Results: The mean ± SD age of the women and children was 33±7 years and 35±14 months, respectively. The prevalence of overweight or obesity was 62% and 1% among the mothers and children, respectively. There was no agreement between mothers' perceived own body size and the measured BMI category and between mother-perceived child body size and the measured BMI z-score category. An estimated 60% of mothers preferred a larger body size for themselves with only a third (35%) preferring a smaller body size. Only 12% of mothers preferred a larger body size for their children, compared to 23% who preferred a smaller child size. Significant predictors of overweight/obesity among women were age ≦28 years (OR=2.22, p=0.01), inaccurate body size perception (OR=1.84, p=0.03) and preference for large body size (OR=1.80, p=0.04). Significant predictors of overweight among children were food insecurity (OR=3.33, p=0.04) and mother's inaccurate body size perception (OR=14.70, p<0.0001).

Conclusion: Body size perception may be important for weight control. Interventions to increase awareness of the negative health consequences of large body size could contribute to reducing overweight or obesity in this population.

Keywords: Maternal perception, Body size, Body mass index, Overweight, Obesity

PAB(T5)-3
The Effect of Short-term Free Distribution of the Nutrient Rich Baby Food (KOKO Plus) on Mothers' Subsequent Purchasing Behavior: Experimental Evidence from Ghana

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Background and objectives: Market-based approach for improving infant nutrition is currently emphasized in developing countries because of its potential sustainability. In this approach, mothers are expected to buy nutritionally enhanced complementary food products. However, since efficacy of such products is mothers' important concern, they would not be willing to purchase them without being convinced. We hypothesized that learning effect through free distribution of Koko Plus gives mothers the chance to learn its efficacy and induce demand for it. Therefore, the study tested this hypothesis.

Methods: The balanced panel data used for this study were from our own surveys conducted in August and November-December 2021 in Ghana, consisting of 379 mother-child pairs with baseline ages of children ranging from 6 to 20 months. We used the Becker-DeGroot-Marschak mechanism to elicit mothers' willingness-to-pay (WTP) for KOKO Plus. There were 4 treatment arms: (1) free distribution of KOKO Plus for one month, (2) free distribution for two months, (3) free distribution

for three months, and (4) control. Twelve Child Welfare Clinics were randomly assigned to one of the four study arms. Linear regression model was used to assess the effects of the free distribution on mother's WTP and demand for KOKO Plus.

Results: After controlling for pre-intervention status of the outcome variables, mothers who received one-month free distribution had higher WTP for 10 packages of KOKO Plus (β= 0.76 GHS; 95% CI: 0.19, 1.32) and bought more KOKO Plus in the past one month (β= 2.96 packages; 95% CI: 1.40, 4.52) than the control group. However, there were no statistically significant differences between the control group and the other treatment groups.

Conclusions: One-month free distribution of KOKO Plus significantly increased mothers' demand. This result indicates the short-term free distribution can induce the learning effect for product efficacy. However, longer free distribution did not have the effects. This may be because long-term free distribution makes beneficiaries acclimatized to being free.

Keywords: Market-based approach, Free distribution, Complementary food, Willingness-to-pay, Ghana

Conflict of Interest Disclosure: This study was funded by the Ajinomoto Foundation.

PAB(T5)-4
Behavior Change Communication improves breast milk intake measured by the Dose-to-Mother Deuterium Oxide Dilution among infants aged 4-5 months in rural Senegal

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Background and objectives: Breastfeeding promotion is widely recognized as one of the most cost-effective investments to promote optimal child health, growth and development. Several studies have shown that breastfeeding education and counselling interventions have a significant impact on improving breastfeeding practices, including exclusive breastfeeding (EBF) rates and breastfeeding duration. However, very few studies have assessed the association between participation of breastfeeding counselling session and infant milk intake. This study aimed to investigate the association between infants' breast milk intake and mothers' participation in behavior change communication provided by the Nutrition Enhancement Program (NEP) and other associated factors.

Methods: A comparative cross-sectional study was conducted in 12 local communities in rural Senegal, six of which were located in the NEP area and the remaining, in the non-intervention area. Breast milk intake and EBF were measured using the deuterium oxide dose-to-mother dilution technique in 140 mother-infant pairs aged 4-5 months. Mothers' knowledge and practices on IYCF were assessed by questionnaire and nutritional status of mothers and infants was measured by anthropometry. Student's t-test, ANOVA and chi-square test were used to compare means and percentages. A mixed model linear regression was performed to identify factors associated with breast milk intake.

Results: Daily breast milk intake was significantly higher in infants from the NEP area (994.7 ±197.3 g/d), compared to those from the non-NEP area (913.6 ± 222.8 g/d), p=0.023. Participation in behavior change communication activities is associated with a higher infants breast milk consumption of 80.0 g/d compared to those whose mothers did not participated (p=0.013). Non-exclusively breastfed infants consumed 74.4 g/d less milk than exclusively breastfed infants (p=0.035). Giving infants porridge reduced their breast milk intake by 182.6 g/d (p<0.001). Stunted and wasted infants had a lower breast milk intake of 119.6 g/d (p=0.023) and 199.4 g/d (p<0.001) respectively, compared to infants with normal nutritional status.

Conclusions: Breastfeeding education and counselling received by mothers through the NEP's Behavior Change Communication intervention has contributed to improve infant milk intake in rural Senegal. Strengthening these activities could have an impact on reducing stunting and wasting in young children.

Keywords: Breast Milk Intake, Deuterium oxide dilution, Behavior change communication, Senegal

Conflict of Interest Disclosure: The authors declare that they have no conflicts of interest.

Further Collaborators: This study was conducted within the framework of the interregional project INT6058 of International Atomic Energy Agency (IAEA) and support by the Conseil National de Développement de la Nutrition (CNDN) of Senegal and UNICEF who have funded all the operational costs of the study.

PAB(T5)-5
Complementary feeding practices and nutritional status of infants and children aged 6-23 months in Nyeri County, Kenya.

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ABSTRACT

Complementary feeding practices and nutritional status of infants and children aged 6-23 months in Nyeri County, Kenya.

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Background and Objectives: Malnutrition remains a public health problem among children in most of the countries in Sub-Sahara Africa. It contributes to high morbidity and mortality of these children. One of the main causes of the high prevalence of malnutrition is poor complementary feeding practices. The objective of this study was to evaluate complementary feeding practices, and the nutrition status of children aged 6-23 months attending child clinics in Nyeri County-Kenya.

Methods: This prospective comparative study followed up 380 mother-child pairs. A nutrition education package was provided to participants from the intervention group and followed up for 3 months. Consecutive sampling was used to recruit the participants' at each clinic until the required sample size was realized. Pre-tested and structured questionnaires was used to collect baseline data for indicators of meal frequency, dietary diversity and acceptable diet as per World Health Organization (WHO) Global Strategy for Infant and Young Child Feeding recommendations. Three indices of nutritional status of children (wasting, stunting and under-weight) were expressed as standard deviation units from the median for the child growth standards recommended by WHO.

Results: Despite food availability, about one-third (32%) of the children 6-23 months received less than the threshold of minimum dietary diversity that is 4 out of the identified 7 food groups. Approximately one out of five children (21%) had minimum acceptable diet. The proportion of children whose weight-for-age below minus two standard deviations (-2 SD) and above two standard deviations (+2 SD) was 2% and about 6% respectively.

Conclusions: Child-feeding practices was sub-optimal with evidence of low acceptable diet and dietary diversity. Approximately one out of ten children was malnourished.

Keywords: Dietary diversity, Acceptable diet, Feeding practices, Nutritional status

PAB(T5)-6
Investigation of food diversity of children under five in Mzimba, Malawi

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Background and Objectives: In Malawi, a lot of foods and many varieties of foods are available at markets. However, more than a half of children under five were malnourished. This gap between high availability of foods and a high appearance rate of child malnutrition suggested that foods at markets were not reaching children properly. In order to know the real food-intake of children under 5 and their food procurement processes, we conducted an HDDS (Household Dietary Diversity Score; developed by United Nations) survey by using a 24-hour recall method.

Method: We selected 151 children under 5 years of age randomly in Manyamula, Mzimba, Malawi. Of them, 24 children were age 0-5 months, 51 were 6-23 months, and 76 were 24-59 months. Then we conducted home-visits to those target children and collected information from their mothers about what foods their children had eaten and how those foods were acquired. We simultaneously measured the children's height and weight. For this survey, we got ethical permission from the ethical committee of local government and informed consents from each household.

Results: Among 16 food groups, the only 5 food groups were eaten by nearly 100% of the target children and only 3 food groups were eaten by 50%. The remaining 8 food groups such as fish, animal meats, dairy products and vitamin A rich food groups were hardly eaten by any of them. In their daily lives, village people seldom procure foods for their meals from the market. They do not try new foods. Their foods were mainly supplied by their own agricultural products.

Consideration: Village people were mainly getting foods from their own agricultural products and not procuring them from the market. It seemed quite difficult to go to the market because of social and geographical difficulties. Vitamin A rich foods were not eaten because they are not produced in the area. They hardly eat house-farmed poultry because house animals are treated not as food stuffs but treasures or emergency foods. These social and cultural problems were disturbing food availability, accessibility and utilization, resulting in poor food diversity.

Keywords: Food diversity, Subsistent agriculture, Food culture, Food availability, Food utilization

PAB(T5)-7
Infant and Young Child Caregiving Practices: Prevalence, Determinants, and Small Doable Actions in Ntcheu and Balaka districts, Malawi

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Background and objectives: One in three children under five years is chronically malnourished and two thirds are anaemic in Malawi. A range of factors have been associated with malnutrition (low birth weight, poor dietary diversity, frequent disease, low use of health and nutrition services, poverty, food insecurity, gender inequality), however there is little in-depth evidence on the context specific determinants of under-five caregiving behaviours and which small doable behaviours to prioritise and promote at scale. This mixed method research

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

answers these questions to guide scale up of Malawi's nutrition and early child development intervention package.

Methods: The presentation will draw on qualitative and quantitative research: 1) an Immersion Research using the Reality Check Approach (RCA) and Human-Centred Design in 12 households to understand current practices, determinants and test small doable actions; 2) a large household survey of around 3,000 mother and child pairs to assess coverage of recommended behaviours. Both methods are centred around Nurturing Care behaviours for optimal child growth and development.

Results: The findings (available in July 2022) will provide deep insight into current context specific caregiving behaviours across the nurturing care framework in these two districts of Malawi. They will include prevalence and coverage data of recommended caregiving practices, qualitative descriptions of the factors influencing those behaviours and a list of tested priority "small doable actions" to promote through existing community platforms (mother support groups, preschools, etc).

Conclusions: This presentation is unique because it combines findings from ethnographic (immersion) research, people centered design and quantitative methodologies to identify scalable behaviour change solutions to improve nutrition and early child development. These findings will help the government of Malawi scale up their integrated Nutrition and Early Child Development intervention package (supported by the World Bank Investing in Early Years programme). The innovative mixed research method to identify and prioritise small doable behaviours is relevant globally.

Keywords: Malawi, Practices, Caregiving, Early Child Development, Infant and Young Child Feeding

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: Power of Nutrition (the funder), Government of Malawi

PAB(T5)-8
Nutritional guidance to infant and young child caregivers in the context of public health facilities in Peru

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Background and objectives: The PERUSANO project aimed to develop new culturally appropriate interventions and actions to reduce the risk of micronutrient deficiencies and overweight/obesity in infants and young children (IYC) aged 6–23-months. We aimed to identify socio-cultural and environmental influences on IYC feeding practices to inform co-designed interventions. This study aimed to present qualitative findings from health centres (HC) to aid the development of appropriate health provider and policy nutrition intervention strategies.

Methods: This qualitative study was conducted in two low-income periurban areas between November 2019 and August 2020. We conducted interviews with 10 healthcare professionals (HP) and observations of 36 well baby consultations and 4 waiting areas of HCs to understand consultation routines relating to IYC feeding practices. The data were transcribed and analyzed using a grounded approach.

Results: IYC health services take place in a tense environment with limited space, high demand, crowding, long waiting times and restless children. The HP focus on nutritional assessment with anthropometric measurements, hemoglobin screening and asking about dietary practices and iron supplementation. Messages for anemia control predominate including recommendations for animal source foods and iron supplements and there is little focus on the prevention of overweight and obesity. Individual needs of children and concerns expressed by the caregivers about children's poor appetite are not addressed. Expository, unidirectional counselling predominates, without the use of educational support materials. A lack of cultural sensitivity and a judgmental attitude prevails. Marked competition between attending to the caregiver/child and completing the registration of various forms as required by the health system in the short time available was observed.

Conclusions: Nutritional guidance for caregivers occurs within a context that limits optimal counselling at the environmental, structural, attitudinal, and procedural levels. There is a need to promote behavior change for optimum IYC feeding practices and not only to provide information. Education and communication materials need to be adjusted to facilitate counselling in the conditions and limitations within which care is provided and to cover the changing nutritional challenges faced by infants in this context including risk for overweight and obesity.

Keywords: Nutrition guidance, Health services, Health personnel, Infant and young child feeding, Peru

Further Collaborators: Rossina Pareja, Luzvelia Alvarez Ortega, Silna Teresita Vela López, Sissy Espinoza Bernardo

PAB(T5)-9
What kind of "fish-based meals" do preschoolers eat at nursery schools? Based on Analysis of School Lunch Menus of 24 Nursery Schools

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Background and objectives: N-3 polyunsaturated fatty acids, which are abundant in fish, have been shown to be beneficial not only in the prevention of lifestyle-related diseases but also in child development. Our goal is to develop an early childhood version of a nutrition education program based on the concept of "the relationship between fish, humans, and the environment

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

in Japan. Accordingly, the objective of this study was to obtain the data of what kind of "fish-based meals" preschoolers eat at nursery schools.

Methods: In June 2019, we collected the data on the 12 menus at 24 nursery schools in the same corporation. The main analysis were the kind, cooking method, and portion sizes of fish dishes.

Results: We collected data from 269 menus. Many types of fish were used for staples, main dishes, side dishes, and soups. In the main dish, fish dishes accounted for 93 of 245 dishes (38.0%), less than meat dishes. Twenty-nine different types of seafood were used, with white salmon being the most common, followed by pacific cod. The average portion size per person was 44g for white salmon and 51g for pacific cod. The weight of the fish main dish ranged from 30 to 50 grams per serving. The only fish dish with a head and tail was wakasagi fritters. Grilled fish dishes were the most common cooking method, followed by fried and simmered dishes. In the side dishes, 15 different types of fish were used, appearing in 83 of the 269 menus. The most frequently appearing fish types were grilled chikuwa and bonito flakes, followed by dried young sardines and canned tuna.

Conclusions: Salmon, dried shirasu (dried young sardines), and bonito flakes are proposed as subjects for the food education program, based on fish dishes that are familiar to Japanese preschooler.

Keywords: Preschooler, nursery school, nutrition education, fish dishes

PAB(T5)-10
Exploring resilience mechanisms against acute malnutrition in children under five in the health zone of Kalemie 2020: a qualitative study

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Background: Despite several interventions implemented in the nutrition field, acute malnutrition among children under five years remains a very serious public health problem in the Kalemie Health zone in the Democratic Republic of Congo (DRC). This study aimed to explore the individual and community resilience mechanisms of acute malnutrition to contribute to the improvement of the health status of children under five. **Methods**: A case study using a qualitative approach was undertaken from December 1 to 31, 2020 in the Kalemie health zone. Both households with an acute malnutrition child and households without an acute malnutrition child were selected to participate. The key informants (community leaders, health care providers, and NGO partners) were approached. Four FGDs with mothers and twenty-four in-depth interviews were conducted and data were analyzed using inductive techniques. The triangulation method was applied. **Results**: A total of sixty-four people took part in the study, including forty during the FGDs and twenty-four during the interviews. The household sensitization on infant and young child food (IYCF), the small business activities, agriculture, food imports, fishing, the household livestock, the establishment of cooperatives through humanitarian aid to meet needs were the main resilience mechanisms identified to fight against acute malnutrition. **Conclusions**: Community and individual resilience capacities through sensitization of target groups effectively prevent malnutrition in children under 5 years old.

Keyword: Resilience, Mechanisms, acute malnutrition, Kalemie, DRC

Conflict of Interest Disclosure: No conflict of interest

PAB(T5)-11
Effect of a mobile health education intervention on nutritional status of children under-5: a quasi-experimental study

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Background and objectives: Despite several interventions implemented by Ghana's Ministry of Health, malnutrition remain high in rural Ghana. Innovative approaches involving the use of mobile technology for improving the nutritional status of children remains a grey area. This study aimed to assess the effect of a theory-driven mobile health intervention on the nutritional status of children under-5 in rural communities of the Ashanti Region.

Methods: We conducted a quasi-experimental pre-post study with a non-randomly assigned control group. A total of 648 caregivers were interviewed; 324 assigned to the intervention group and 324 in the control group. For 6 months, caregivers in the intervention group received bi-weekly voice short message service (SMS) on nutrition-related messages based on the Health Belief Model (HBM). The treatment effect was examined using Difference-in-Difference (DiD) analyses. Nutritional status was assessed through anthropometry. Data was analysed using Stata version 16.

Results: The prevalence of wasting was 7.54%, underweight, 11.67% and stunting, 19.67% at baseline. The multivariate logistic regression analyses showed that gender of child (aOR=0.31; 95% CI: 0.36-0.82), age of child (aOR=3 .48, CI: 3.48, 95% CI: 1.11-10.89), caregiver's knowledge on child nutrition (aOR=0.31; 95% CI: 0.12-0.81) and ability of caregiver to read and write (aOR= 3.48; 95% CI: 1.54-9.53) were significantly associated with malnutrition in children under-5. Overall, there was a statistically significant reduction of wasting, underweight and stunting of 26.8% (Diff-in-diff=-0.268; t= 5.47; p<0.001) observed after the 6-month period. **Conclusion**: Mobile phones can serve as effective tools to increase the level of knowledge of caregivers and further improve the nutritional status of children under-5 in rural communities.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Nutrition, Mobile phones, mHealth, Nutritional Status, Health Belief Model
Conflict of Interest Disclosure: None
Further Collaborators: None

PAB(T5)-12
Impact of Differences in Involvement of Childcare Workers on Food Education to Know the "Blessing of Nature" in Early Childhood

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Background and objectives: In Japan, "the Basic Law on Food Education" (2005) indicates the significance of consumption and production in harmony with the blessings of nature and the environment. To understand the "blessing of nature," food education has been implemented in childcare settings. However, it does not specifically state what should be implemented, and childcare workers only understand the phrase "blessing of nature."[1] Therefore, food education with the theme of "photosynthesis" was implemented. As a result, there were cases where children made remarks about the "blessing of nature," and cases where they did not. Thus, this study aimed to compare the two circumstances and clarify how the involvement of childcare workers affected children's remarks.

Methods: From 2019 to 2021, food education with the theme of "photosynthesis," which involves the entire process from growing food to consuming food, was implemented on 54 kindergarten children aged four–five years. Children's remarks and appearances were recorded based on childcare records and guardian questionnaires. We compared how differences in the involvement of childcare workers affected children's food education activities.

Results: In cases where childcare workers understood that children would independently realize the objective of food education as being the "blessing of nature," children made remarks about the blessing of nature. In cases where childcare workers did not understand that childcare workers were observed to have taught the blessing of nature to children in words, and the children made few remarks about the blessing of nature.

Conclusions: It is important for children to independently perform activities in order to make food education, which includes learning about the "blessing of nature," successful in childcare settings. It is important for all childcare workers and guardians dealing with children to understand the objective of food education and get involved by empathizing with the fact that children will learn about the blessings of nature with real feelings involved, such as being marveled or touched, instead of teaching the "blessing of nature" in words.

Keyword: Food Education, Blessing of Nature, Early Childhood, Childcare Workers

PAB(T5)-13
Effectiveness of a Family-based Cluster Randomized Intervention Delivered through School Health Nurses on Reducing Intake of Discretionary Foods and Drinks in Schoolchildren

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Background and objective: The intake of sugar-rich discretionary foods and drinks, such as sweets, cake, ice cream, and sodas, is much higher than recommended among Danish children. Public health interventions have focused on promoting healthy food, with less attention on discretionary choices. Strategies to limit the intake of discretionary foods and drinks among children are therefore needed. The objective of this study was to test the effectiveness of an intervention with focus on discretionary choices.

Methods: The "real-life" trial "Are You too Sweet" tested a range of knowledge- and behavioral capability-building components and strategies for reducing consumption of discretionary foods and drinks among school starters, 5-7 y. The trial was conducted as a two-arm, parallel, cluster-randomized controlled trial, running for 3.5-months in the period from October 2020 until March 2021. The intervention was delivered to participating families through collaboration with the local school health nurse in a Danish municipality (Hvidovre). The intervention entailed multiple components developed based on Social Cognitive Theory (SCT) and consisted of a sugar-rich food screener, extended consultation at the school health nurse, an online Facebook group and a take-home box. The take-home box contained a card game connected with a digital learning universe with a Sweet-monster-avatar, a portion guide with stickers, a children's book and an inspiration booklet. The intervention group was compared to a control group receiving standard care from the school health nurse.

Results: A total of 153 children and their parent's accepted the invitation to participate, and 148 completed the dietary record according to the protocol (n intervention group= 93, n control group=55). Preliminary results show that children in the intervention group reduced their intake of discretionary foods and drinks by weight by 30% compared to children in the control group (p=0.01) during the intervention. No change in intake of energy or food sub-groups were detected compared to the control group.

Conclusion: Results indicate that delivering messages through school health nurses might be an effective way to provide families with tools and knowledge to restrict the intake of discretionary foods and drinks among schoolchildren. Effective tools for behaviour changes are further worth illuminating.

Keyword: Discretionary food, Family-based interventions, Dietary recommendations, Child nutrition, Sugar intake

Further Collaborators: The study has been developed in collaboration with Hvidovre Municipality, Denmark, Serious Games Interactive and FRIDAY.

PAB(T5)-14
Relationship between eating behavior during snack time and sports activities among elementary school children

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Background and objectives: Elementary school students who learn sports have a clearer purpose of eating than those who do not learn sports, which indicates a relationship between sports lessons and eating behavior. However, it has not yet been verified how "food-related factors," "personal factors," and "environmental factors" of eating behavior are related to snacking among these students. Therefore, this study aimed to clarify the factors related to eating behavior during snack time among elementary school students who learn sports.

Methods: The subjects were students from 3rd grade to 6th grade of an elementary school (n = 1096). The survey used an anonymous self-administered questionnaire. The response rate was 96.0%. Items included attributes of participants, items related to actual situation of each lesson and actual situation of snacking, and factors influencing eating behavior. Participants were divided into two groups: those with a sense of purpose for snacking (conscious group) and those without a sense of purpose for snacking (unconscious group). The analysis was performed using crosstab and χ^2 test.

Results: Boys in 3rd and 4th grades who learn sports were conscious and related to "what to do if a snack that they had never eaten" was served (p = 0.002). Boys in 5th and 6th grades were more conscious of sports lessons and concerned about what is written on bags and boxes and the names of snacks, than the others. Among girls, learning sports was not associated with eating behavior regardless of their grade and awareness of snacking.

Conclusions: Among boys, snacking was associated with sports lessons and a sense of purpose in snacking. "Food-related factors (food experience)" and "individual factors (inter-individual factors)" of 3rd and 4th graders and "environmental factors (information environment)" of 5th and 6th graders were related to sports lessons and eating behavior. Among girls, sports lessons and eating behavior were not related regardless of whether there was a sense of purpose for sports lessons and snack intake.

Keyword: Food choice, Children, Lessons, Snack

Further Collaborators: Kamisato Town Board of Education

PAB(T5)-15
The effectiveness of a non-face-to-face cooking program to enhance self-esteem in elementary school students

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Background and objectives: Japanese children have lower self-esteem than children in other countries. Longitudinal studies have shown that low self-esteem in childhood can lead to negative outcomes such as depression, suicidal thoughts, and risky behaviors like smoking. However, recent cross-sectional studies have shown that increased cooking experience is associated with improved self-esteem. Therefore, we have been experimenting with a cooking experience program to enhance self-esteem. This study aims to determine the effectiveness of a non-face-to-face cooking program that can be implemented during the COVID-19 pandemic period with the aim of enhancing self-esteem among elementary school students.

Methods: This research used a quasi-experimental design. The intervention was conducted from July to September 2021 once a week for a total of five sessions among fourth- through sixth-graders. The intervention group (24 participants) received cooking videos and ingredients with feedback on their efforts. The control group (29 participants) received only ingredients and paper recipes. To evaluate self-esteem, we used a scale whose reliability and validity were confirmed by previous studies (score range: 8–32 points).

Results: The results of the post-program questionnaire were not available for one participant each in the intervention and control groups. There was no difference between groups in gender, grade, or self-esteem before participation. The median self-esteem score (25th, 75th percentile) increased significantly in the intervention group from 23.0 (21.0, 25.0) before to 25.0 (20.0, 28.0) after program participation ($P < 0.05$), and there was a significant difference in the amount of change between groups ($P < 0.05$). The frequency of receiving praise from family members also increased significantly only in the intervention group.

Conclusions: This program may promote good communication among family members and enhance self-esteem through cooking experience.

Keyword: self-esteem, cooking, elementary school students, family, non-face-to-face

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-16
Effects of dietary experiences in elementary school on interest in nutrition education and subsequent attitudes toward healthy eating habits in adulthood

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Background and Objectives: Healthy eating habits are important for good mental and physical health. To promote nutrition education for adopting healthy eating habits, the factors that encourage healthy eating habits must be identified. Therefore, this study investigated the effects of dietary experiences in elementary school on interest in nutrition education and subsequent attitudes toward healthy eating habits in adulthood.

Methods: Data from The Survey of Attitude toward Shokuiku, 2019, Ministry of Agriculture, Forestry and Fisheries in Japan provided by the Social Science Japan Data Archive, Center for Social Research and Data Archives, Institute of Social Science, The University of Tokyo was used for this secondary analysis. Participants comprised 1721 adults aged 20–90 years (759 men, 962 women, mean age = 56.13, *SD* = 17.53). The survey items used for the analysis pertained to the present degree of interest in nutrition education and attitudes toward healthy eating habits. Furthermore, 13 items assessing the degree of eating behaviors in elementary school have also been used for the analysis. For example, eating meals at regular times at home, expressing appreciation for foods and people who provide or produce them before and after a meal at home, and listening to or receiving food guidance from teachers at school.

Results: The correlation analysis showed that helping prepare the meal and cleaning up after at home, and having conversations with family members about food during meals at home had a positive effect on interest in nutrition education. Additionally, helping prepare the meal and cleaning up after at home had a positive effect on attitudes toward healthy eating habits.

Conclusions: This study provides some insight into the aspects of dietary experiences that are most effective in childhood. The results of this study suggest that food experiences within the home are important, and proactive involvement in food preparation is significant. Interestingly, including seasonal ingredients is an important factor. Future studies should explore the effects of these experiences in detail.

Keyword: nutrition education, eating habits, dietary experiences, elementary school, retrospective research

PAB(T5)-17
Changes in elementary school children after a two-year nutrition education intervention that encourages home cooking experience

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Background and objectives: In a cross-sectional study of children, it was reported that cooking experience affects dietary concept and self-esteem. However, there are only a few reports on interventions. In this study, we conducted a two-year nutrition education intervention to encourage home cooking and examined changes in dietary concept, self-esteem, and evaluation of breakfast dietary balance with increased cooking experience.

Methods: A self-administered questionnaire was administered before and after the intervention to 327 elementary school children aged 9-12 years during 2016-2019. The data of 202 participants (61.8%) who responded validly both before and after the intervention were analyzed. The intervention involved distributing and explaining the workbook that was designed to encourage children to cook at home. In the questionnaire, cooking experience was classified into five subcategories: frequency of cooking, self-efficacy in cooking, cooking technique, dietary planning, and hygiene management; dietary concept was classified into one subcategory; self-esteem was classified into three subcategories: self-evaluation and self-acceptance, self in relationship, and self-assertion and self-determination. Three or more items were set for each subcategory, and the options were scored to calculate the mean score for each subcategory. We assessed what foods and dishes the children ate for breakfast. We used the "Breakfast dietary Balance Score" and rated one point for each of the six categories of food consumed. The participants were divided into two groups according to the change in the mean score of the cooking experience category (Decrease and Low maintenance group; DL and Increase and High maintenance group; IH).

Results: Of the respondents, 80.6% of the boys and 73.4% of the girls were in the IH group. The results of the pre-post comparison showed that both DL and IH girls had a lower dietary concept and self-esteem ($p<0.05$). The analysis of covariance showed that IH was higher than DL for both sexes in dietary concept and two subcategories of self-esteem ($p<0.05$). The breakfast dietary balance scores were significantly higher for girls ($p<0.05$).

Conclusions: Cooking experience could lead to desirable changes in dietary concept, self-esteem, and breakfast dietary balance scores.

Keyword: cooking experience, dietary concept, self-esteem, breakfast dietary balance score, elementary school children

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-18
Factor Structure of Enjoyable Eating in Schoolchildren

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Background and Objectives: To realize “enjoyable eating (EE)” that is unique to oneself throughout life, it is necessary to clarify the factors that influence EE in schoolchildren, which strongly affects the way they will eat for the rest of their lives. The purpose of this study was to qualitatively clarify the factor structure of EE in schoolchildren.

Methods: A hypothetical model of EE was developed and an interview guide was developed based on the model. Using the developed guide, individual semi-structured life story interviews were conducted with 12 fourth-year students (6 men and 6 women) enrolled in the School of Nutrition and Dietetics at N University from August 2020 to August 2021, with each interview lasting approximately 1 hour. The interviews were recorded and transcribed verbatim, and the variables of EE were extracted from the transcripts and embedded in the hypothetical model in order to examine the factors of EE in schoolchildren.

Results: The initial hypothetical model of EE was developed from the following concepts: 1. diet-related behavior, 2. taste and affective factors, 3. personal factors that influence eating behavior (personal factors), and 4. other influencing factors. The hypothetical model was then reconstructed by embedding the extracted variables into the model. It was found that EE is formed by 2. taste and affective factors, 3. personal factors, and the availability of 4. other influencing factors, as well as by practicing 1. diet related-behavior. In schoolchildren, “school” was the key word because school influences 3. personal factors, and as a result, the approach to EE changes. This cycle is repeated, and one's own style of EE is established.

Conclusion: It is clear that schoolchildren are more strongly influenced by 4. other influencing factors than by 3. personal factors. We believe that is because schoolchildren are strongly influenced by school and family members who prepare food for them. However, the importance of 3. personal factors that demonstrate initiative and individuality was also confirmed. We believe that EE in schoolchildren means that they can develop their independence in the environment that surrounds them and exercise their own individuality in terms of eating habits.

Keyword: Enjoyable Eating, Schoolchildren, Life story interview, Influencing factor, Eating behavior

Further Collaborators: Namiko Adachi

PAB(T5)-19
Creating a system for evaluating Shokuiku (food and nutrition education) in Japanese schools

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Background and objectives: To promote Shokuiku(food and nutrition education) in schools, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) prepared a "Guide to Teaching about Food" in 2007 and revised in 2010, showing how to teach Shokuiku with the aim of forming desirable dietary habits in children. Using survey data conducted by the Nutrition Education Committee of the Japanese Society of Health Education and Promotion, this study compared the necessities for investigations and evaluations on Shokuiku in Japanese schools by the method of meal preparation.

Methods: From November 2018 to January 2019, we conducted an anonymous self-administered questionnaire survey on 262 nutrition teachers and school nutrition staff in Gunma, Tochigi, Chiba, Saitama, and Hiroshima prefectures in Japan (valid response rate: 37.4%). We compared the implementation status of investigations and evaluations on Shokuiku according to the meal preparation method using Chi-square test or Fisher's exact probability test. In addition, we qualitatively analyzed free responses on "reasons why the system for evaluations of the Shokuiku plan is not established.”.

Results: Respondents in the school lunch center group were less likely to report the involvement of a president and a vice-president in evaluation of the Shokuiku plan than those in the onsite group. There were no significant differences between the groups in involvement of diet and nutrition teachers, nursing teachers, and teachers in charge of Shokuiku. As for reasons why the system is not established, seven categories, such as insufficient skills for investigation and evaluation, were extracted from the onsite group and 7 categories, such as difficulties of cooperation between the center and distributed schools, were extracted from the school lunch center group.

Conclusions: It was demonstrated that to investigate and evaluate in relation to food, it is necessary to (1) develop systems inside and outside school, (2) position food and nutrition education within the curriculum, (3) cooperate with managers and teaching and administrative staff, (4) secure time and labor for investigation and evaluation, and (5) construct tabulation systems.

Keyword: School, food and nutrition education, evaluation, system

PAB(T5)-20

Changes in food awareness and attitudes of Japanese first-year elementary school students who eat school lunches, as perceived by parents

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Objective: School lunches in Japan not only have to meet the nutritional needs of children, but also is playing an important role in the development of a proper understanding and appropriate discernment of food in children. This study aimed to clarify changes in food awareness and attitudes of Japanese first-year elementary school students who eat school lunches.

Methods: A survey was conducted of 827 parents of children enrolled in 11 different elementary schools in Matsumoto City in Nagano Prefecture. The parents were asked to complete a questionnaire upon their child's enrollment in elementary school (April 2021) and at 2 months (June), 3 months (July), and 6 months (October) after the start of school lunch. The questionnaire from April and June were collected and 516 parents who answered both questionnaires were subject to analysis. As analysis, chi-squared tests were used. A p-value less than 0.05 was considered statistically significant.

Results: 424 (82.0% of valid answers, same hereafter) children had a strong or moderate interest in food upon enrollment. In June, 373 (73.0%) children talked about school lunches at home. The number of children who developed a strong interest in eating and food after starting to eat school lunches was 196 (38.3%) and 246 (48.0%) children talked more about food, 162 (31.6%) children had fewer expression of likes and dislikes of food, and 187 (36.5%) children had started to enjoy eating meals. Interest in food upon enrollment and the frequency of talking about food were not found to be associated with the presence or absence of experience of meals at nursery school or another institution. Significantly more children with an interest in food upon enrollment moved in the right direction in terms of interest in food, talking about food, food-related likes and dislikes, and enjoyment of eating in June.

Conclusions: School lunches appeared to be a major topic of interest among first-year elementary school students. School lunches had a considerable positive impact on children's food awareness and attitudes. This study was conducted with the aid of a grant from the Japan Dairy Association (J-milk).

Keyword: School lunches, First-year elementary school students, Food awareness, Food attitude, Japan

Conflict of Interest Disclosure: This study was conducted with the aid of a grant from the Japan Dairy Association (J-milk).

PAB(T5)-21

Nutrition Education Methods for Students and Parents with Its Influence to The Vegetables, Fruits and Fish Consumption Behavior

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Background and Objectives: The behavior of consuming less vegetables, fruit and fish is still a nutritional problem in Indonesia. Vegetables and fruit are a source of vitamins, minerals and fiber that the body needs and fish is a source of protein containing omega 3 which is good for children's brain development. Efforts to increase consumption directly by providing vegetables, fruit and fish at home and providing nutrition education to increase knowledge, build positive attitudes and good consumption behavior in students, teachers and parents. This study aims to examine the effectiveness of the nutrition education method on students and parents and their effect on the consumption behavior of vegetables, fruit and fish.

Methods: The research method used a quasi-experimental pretest and posttest control group design. There are five study groups with a total sample of 85 students and 51 mothers. There are five study groups; (A) student group; parents with video; games, (B) student group with video; games, (C) student group with lecture; practice, (D) student group; parents with lecture; practice and, (E) control group students; parents, were not given any intervention. Nutrition education through lectures and videos is given four times in four weeks.

Result: The results of the N-gain score test show that nutrition education is quite effective in increasing knowledge in all nutrition education intervention groups, increasing respondents' attitudes is most effective in group (A), and quite effective in improving practice in group (D). The effectiveness of nutrition education on mother's knowledge, attitudes and practices showed that nutrition education was not effective in increasing knowledge because mother's knowledge was quite good before the intervention, but both methods were effective in improving mother's attitude, and the lecture method; practice was quite effective in improving mother's practice.

Conclusion: Nutrition education was quite effective in increasing knowledge in all study groups given the intervention compared to the control group. However, for improving practice, it was quite effective only in the student intervention group; parents in the lecture method; practice. Nutrition education involving parents had a significant effect on increasing knowledge, attitudes and practices of mothers in the intervention group compared to the control group.

Keyword: effectiveness of nutrition education, parental involvement, fruits, vegetables, fish

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-22

Breakfast consumption and its relationship to knowledge, attitudes, self-efficacy and lifestyle factors among primary school students and junior high school students in Osaka: suggestions for future nutrition education

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Background and objectives: One of the goals of the Fourth Basic Plan for the Promotion of Shokuiku in Japan is to decrease the percentage of citizens skipping breakfast. The goal is set as 0% for the students' age group. The aim of the study is to identify mutual/unique factors related to skipping breakfast and breakfast quality among primary school students (PSS) and junior high school students (JHSS) in Osaka, Japan in order to suggest a group-appropriate educational approach.

Methods: A self-administrated questionnaire survey was conducted from May to June in 2021. Participants were 427 students of the 5th grade and 6th grade from four public primary schools and 1282 students of the 7th and 8th grade from seven public junior high schools. Binary logistic regression analyses separated by PSS and JHSS were performed to calculate adjusted odds ratios for skipping breakfast and breakfast quality. Knowledge, attitudes, self-efficacy towards breakfast or healthy lifestyles and lifestyle factors were set as independent variables.

Results: The rate of breakfast skipping was 20.6% among PSS and 22.9% among JHSS. The rate of students who have a well-balanced breakfast regularly was 64.4% among PSS and 30.6% among JHSS. The logistic regression analysis indicated that, for skipping breakfast, late bedtime hour was a mutual factor among PSS and JHSS. Furthermore, lack of sleep was a negative factor in PSS and waking up late, not believing that breakfast can enhance concentration in the morning, negative attitude towards eating and low self-efficacy towards healthy lifestyle were the negative factors among JHSS. Regarding good breakfast quality, a good attitude towards a healthy lifestyle was the only positive factor among in PSS, and sleeping late, low self-efficacy towards menu planning of a well-balanced breakfast and self-efficacy towards cooking breakfast were the negative factors among JHSS.

Conclusions: Our findings suggest that future nutrition education needs to emphasize the importance of healthy lifestyle practices particularly sleeping habits to reduce skipping breakfast and to encourage a well-balanced breakfast for both PSS and JHSS. In addition, nutrition education should include activities to raise self-efficacy specifically towards diet quality to improve breakfast quality among JHSS.

Keyword: Skipping breakfast, Breakfast quality, Adolescents, Self-efficacy, Lifestyle

PAB(T5)-23

Dietary status of high school students, and effects of nutrition education on the status to the students.

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Background and Objectives: The eating habits of high school students may have many problems due to changes in the individual living environment and further independence of a life style which is controlled by themselves. It is necessary to encourage young people such as high school students to acquire and practice healthy eating habits such as "having breakfast every day" and "increasing vegetable intake". We aim to characterize the diet status of high school students from Osaka, Japan, and to assess their association with nutrition knowledge, life style, physical and mental conditions, and consciousness and action on their diet.

Methods: In total, about 400 students (in 10 classes) aged 15–16 years in high school in Osaka, Japan, participated in the study. Internet questionnaires were distributed twice in all classes in August and November, 2019. A half of them (5 classes, intervention group) participated in nutrition education lessons twice and received some information on food and nutrition 4 times by e-mail. Another half of them (5 classes, non-intervention group) had no lessons.

Results: About 50% of the students sleep more than 6 hours during the night, which is about 10% less than the average. About 85% of them eat breakfast everyday but only 15% of them eat “full breakfast” (3 plates, staple food, main dish and side dish). Their average intake of vegetable is about 250g, which is 100g less than recommended amounts. After education, the intervention group had more knowledge about food and nutrition such as recommended amounts of vegetables, than the non-intervention group or than before the education, but their intake of vegetable after education was as the same as before the education. About 60% of them use their electronic device just before (less than 30 minutes) getting sleep. There is some relation between using electronic devices before bed time to the quality of their breakfast, that is, the longer the group used the electronic device before bed time, the less they tended to have a variety of food as their breakfast.

Conclusion: More approaches are needed in order to change their eating habits such as eating more vegetable.

Keyword: Dietary status, Eating habits, High school students, Nutrition education

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-24
Assessment of lifestyle and eating habits of school-refusing students in Japan

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Background and objectives: The number of school-refusing students (SRS) in Japan is increasing annually. To better understand this trend and develop effective supportive measures for such students, we have surveyed the physical conditions, lifestyle, eating habits, and living environments of Japanese SRS.

Methods: The participants of the survey were students (*n*=119) aged 12–15 years (junior high school students) who refused school and participated in a consultation hosted by a free school in S city, S prefecture; students (*n*=143) attending K junior high school in M city, S prefecture; and their guardians. This study protocol was approved by the Research Ethics Review Board of the University of Shizuoka. The survey was conducted between May 2017 and October 2021 and collected data using physical measurements, a diet and lifestyle questionnaire, and a brief self-administered diet history questionnaire. Statistical analysis was performed using SPSS 27.0 J for Windows (IBM Japan) to compare the SRS and school-attending students (SAS). The significance level was set at $p < 5\%$.

Results: The mean ages of the participants were 13.4±0.8 years (SRS) and 13.3±0.9 years (SAS). There was no significant between-group difference in physical conditions such as height, weight, and BMI. However, the screen time (when using mobile phones and other devices) was significantly longer for SRS than for SAS ($p<0.001$). Moreover, many SRS had low levels of physical activity. As for breakfast, 80.4% of SAS answered that they “eat every day,” but only 40.8% of the SRS reported the same. SRS had significantly lower intakes of energy ($p<0.001$), protein ($p<0.001$), lipids ($p <0.01$), carbohydrates ($p<0.01$), vitamins, and minerals than the SAS. However, when adjusted for energy intake, no significant between-group difference was observed.

Conclusions: Our findings suggest that SRS may not be able to engage in enough physical activity or follow a sufficiently healthy diet and lifestyle to meet the requirements for the growth and development of junior high school students. Early intervention and support for the improvement of eating habits and lifestyle are, therefore, recommended.

Further Collaborators: Nao Araki, Miki Ishihara, Fusako Takahashi

Keyword: school-refusing students, lifestyle, eating habits

PAB(T5)-25
Designing school-based nutrition education interventions using social and behavior change principles to improve dietary practices of adolescent girls in Ethiopia

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Background and objectives: Large-scale interventions implemented through schools have the potential to reach over seventy percent of adolescent girls in Ethiopia. Promotion of healthy food consumption practices among adolescent girls should address their motivations, barriers, and influencing factors. We designed and facilitated the implementation of nutrition interventions delivered through government primary schools to improve the diet of adolescent girls. **Methods**: We applied the socio-ecological model of social and behavior change (SBC) to develop an effective strategy for adolescent nutrition in SNNP (Southern Nations, Nationalities and Peoples) (agrarian) and Somali (pastoralist) regions. Gaps in dietary practices, barriers and motivations, roles of influential persons, and channels of communication were identified. Context-specific intervention models were developed for each region using multiple sources of information and data. Interventions were implemented by school principals, supervisors, teachers, student leaders, community leaders and health extension workers. Program monitoring and participatory problem-solving sessions helped to adapt the interventions, and informed and refined the implementation process. **Results**: School teachers and parents had good knowledge about nutrition prior to interventions, but they were not addressing the drivers of adolescents' dietary behaviors. Interventions were developed to improve adolescent girls' knowledge, self-efficacy, social norms, and beliefs by engaging parents, teachers, and peers in interactive dialogue conducted through multiple existing school-based activities that were streamlined to easily integrate into existing events such as flag ceremonies, school clubs/peer to peer sessions, and classroom lessons. Hands-on, participatory, face to face communication aided by audiovisual materials were used. Student take-home materials were used to reach parents; contacts were expanded through parent-teacher meetings, health worker visits and community events to encourage parents to provide an enabling home food environment. Repeated training, supervision and monitoring were key to solving operational constraints. **Conclusions**: Social and behavior-change principles may be needed to design nutrition education activities for improving dietary practices of adolescent girls. Primary schools can be effective channels for scaling up interventions to improve adolescent nutrition.

Keyword: Adolescent girls, Dietary practices, Nutrition education, Social and behavior change, Ethiopia

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T5)-26

Parent's level of education and dietary patterns among out of school adolescents in Ibadan Nigeria

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Background and objectives: The importance of formal education and well-informed decision-making cannot be underscored in the health and wellbeing of populations. Access to quality education is limited in most low resource environments (particularly among adolescents), where school enrollment and drop-out rates are low and high, respectively. However, little is known about the significance of parents' level of education (PLE) in dietary patterns adherence (DPA) of out-of-school adolescents. This study aims to assess the relationship between PLE and DPA among out-of-school adolescents in Ibadan, Nigeria.

Methods: A cross-section of 190 out-of-school adolescents was identified in Ibadan, and information on age, last school enrollment, and PLE were collected via in-person interviews after due informed consent. Using a semi-quantitative food frequency questionnaire, respondents reported the frequency of food consumption, and principal component analysis was applied to identify two major dietary patterns ('unhealthy' and 'healthy'). A Chi-square test was applied to determine the relationship between PLE and DPA among out-of-school adolescents at P<0.05.

Results: Adolescents with strong adherence to the 'unhealthy' diet patterns were significantly higher (P=0.032) among those who reported having a father (62.3%) or mother (67.1%) with primary school education only compared to a similar population whose father (44.9%) or mother (37.8%) had at least a secondary school education. Contrariwise, the proportion of adolescents with adherence to 'healthy' diet patterns was significantly higher (P=0.017) among those with fathers (55.1%) or mothers (58.6%) who had at least a secondary school education compared with a similar population whose fathers (35.8%) or mother (38.0%) had a primary school education only.

Conclusion: PLE was associated with the DPA among out-of-school adolescents in this population. The importance of continuing parental education might be a promising soft target approach in promoting healthy dietary choices and managing the burden of malnutrition among adolescents from low-resource environments.

Keyword: Parents' education, Dietary adherence, Out-of-school adolescents, Nigeria, Low and middle income countries

PAB(T5)-27

The effects of body image and media on dieting behaviors among Japanese adolescents: suggestions for an educational approach to improve their healthy eating habits.

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Background and objectives: In Japan, dieting has become a serious health problem among girls and young females. It is important for adolescents to build a positive body image. However, such studies are limited in Japan. One of the factors influencing body image is media, a socio-cultural factor. It is recognized as the most influential sociocultural factor. The aim of this study was to examine the effects of media on body image and dieting and to suggest educational approaches to promote healthy eating habits among adolescents.

Methods: Anonymous self-administered questionnaires were administrated to the grade 7 students (n=552) attending three public junior high schools in Osaka Prefecture, Japan in February 2020. The number of valid answers was 375 (boys:181, girls:194). Participants completed a set of demographic questions (height and weight), media use, dieting, body image (perception, ideals, discrepancy), and socio-cultural influence (Sociocultural Attitudes Towards Appearance Questionnaire-4: SATAQ-4). A binomial logistic regression analysis was conducted as well as descriptive statistics and univariate analysis.

Results: Girls (47.0%) were more likely to diet than boys (22.5%) (p<0.001). Binominal logistic regression analysis showed that among girls, dieting was associated with perceiving themselves as being fat regardless of their actual body shapes (OR:95%CI; 2.895:1.292-6.485) and SATAQ4-Media-Pressure scores (1.119:1.025-1.222). There was no significant correlation between body image and dieting among girls. There were no significant factors related to dieting among boys.

Conclusions: This study reported high rates of dieting attempts among girls, which is consistent with other studies. Our findings suggest that nutrition education may have a positive impact among girls, teaching them not to think they are fat and not to internalize thin media-ideals, whereas further studies are needed to find any factors among boys. Being fat is likely to be portrayed negatively in the Japanese society. This may cause adolescents to attempt dieting though their body shapes are mostly standard or slim. Interestingly, understanding the "correct body image" was less important. Health/nutrition educators should remember this and need to teach about "healthy body" carefully. Future nutrition education programs should be more comprehensive, and must build media literacy towards thin-ideals and promote positive body perceptions.

Keyword: Dieting, Body image, Adolescent, Media, Nutrition education

Conflict of Interest Disclosure: None.

Further Collaborators: None.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-28

Increasing speed while maintaining quality: Lessons learned in adapting adolescent nutrition social and behavior change communication materials from Ethiopia to Tanzania

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Background and Objectives: In Tanzania, where 14-18% of adolescents experience malnutrition (TDHS 2010, 2015), the evidence base on adolescent nutrition (AN) has been limited and few nutrition social and behavior change communication (SBCC) materials for adolescents exist. In 2019, Lishe Endelevu, a five-year activity funded by the US Agency for International Development (USAID), faced the challenge of ensuring the rapid implementation of nutrition SBCC programming to improve nutrition outcomes among adolescents in four regions of Tanzania. The Activity made the strategic decision to use the same priority behaviors and adapt evidence-based AN SBCC materials used by USAID/Empowering New Generations to Improve Nutrition and Economic Opportunities Activity in Ethiopia.

Methods: Key steps in the adaptation process included: Review the evidence base on adolescent nutrition in Tanzania and Ethiopia and prioritize nutrition behaviors. Procure copies of AN SBCC materials from Ethiopia and adapt them to the Tanzanian context Pretest the adapted materials with adolescent girls, mothers and fathers of adolescent girls, and teachers. Use the pretest findings to make further revisions to adjust to local Tanzanian context. Submit the materials and pretest report to government authorities for technical review. Incorporate technical review feedback to finalize the materials. Reproduce and disseminate the materials. Train teachers and community volunteers to use the materials. Monitor implementation and document lessons learned.

Results: In less than 2 years from adapting the set of 8 adolescent nutrition SBCC materials from Ethiopia to the Tanzania context, Lishe Endelevu reached 625 teachers and 3952 community health workers who in turn reached 100370 adolescents through 493 in-school nutrition clubs and an additional 72410 adolescents in out of school activities.

Conclusion: Programs can speed up implementation by obtaining existing evidence-based SBCC materials that have had success in other places and developed for similar audiences and contexts following a methodological process to adapt them to a different context. Pretesting materials with the intended audiences, soliciting reviews and feedback from technical experts, and ensuring careful revisions are critical steps in process to adapt materials from other programs.

Keyword: Adolescent nutrition, SBCC materials, Tanzania, Ethiopia

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T5)-29

High Fat, Salt and Sugar (HFSS) food consumption and television advertisements: an undesirable association

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Background and objectives: Easy availability and access to High Fat, Salt and Sugar (HFSS) food is a contributing factor to the increasing burden of childhood obesity. Television food advertisements play an important role in influencing children's choices of food consumption. The present study was planned with the objective to study the association between television food advertisements and consumption of HFSS foods by school age children.

Methods: A total of 378 students studying from 6th to 12th standard were enrolled from an English medium private school in Vadodara city, Gujarat, India and were asked to complete an online self-administered questionnaire related to HFSS food consumption and television advertisements.

Results: Around 70.6%, 81.7%, 71.9% and 83.3% of thin, normal weight, overweight and obese subjects reported HFSS food consumption in the previous 24 hours of the survey respectively. At least one HFSS food product was consumed in the previous 24 hours by 44.5% subjects and 24% subjects reported consumption of two HFSS food products. Around 66.8% of the school children reported that they get information about HFSS foods from television advertisements followed by friends (43.9%) and the internet (43.3%). When asked whether they like to try out the new food products shown in television advertisements, 59.3% subjects replied in the affirmative. Subjects (52.1%) reported trying out new food products shown in television advertisements within a period of one month. Majority (91.1%) subjects reported that they liked to consume HFSS food because they were tasty.

Conclusions: Children need to be sensitized about the ill effects of HFSS food consumption and encouraged to make healthy lifestyle choices. There is a need for implementation and enforcement of existing laws to regulate advertising of different HFSS food products which could help in reducing the intake of HFSS food products by children. Also, there is a need to encourage advertising of healthy foods. Using the medium of television for nutrition education and promoting healthy lifestyle behaviours could help in alleviating the problem of childhood obesity and its associated health risks.

Keyword: HFSS foods, Television advertisements, Childhood obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-30
Evaluation of nutrition education program for prevention of noncommunicable diseases: A case study of sugar intake

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Background and objectives: This study aimed to implement a nutrition education program on sugar intake for university students in Malaysia to prevent noncommunicable diseases (NCDs) and conduct process, impact, and outcome evaluations of this program.

Methods: We conducted a nutrition education workshop that involved 102 students at Universiti Teknologi MARA (UiTM) who responded to a preworkshop survey. The results were analyzed before and after the workshop. A pre- and postworkshop comparison was conducted for 61 students who participated in the postworkshop survey.

Results: The nutrition education workshop was successful overall. More than 80% of the students were glad that they attended the workshop. Subsequently, they expressed a positive view of the nutrition education program and practiced what they had learned. Comparison of the pre- and postnutritional education program data showed improvement in students' knowledge regarding sugar consumption students demonstrated self-efficacy in selecting beverages with little sugar and a high degree of self-awareness by being careful about consuming large amounts of sugar. Furthermore, students demonstrated improvement in behaviors by eating breakfast regularly; skipping breakfast was identified as a preimplementation problem. Moreover, students reduced consumption of sugar-sweetened beverages (SSB), and engaged in exercise. As an evaluation measure of outcomes, we focused on the intake frequency of SSB and sweets. For the daily intake frequency of SSB, the number of people who answered “more than three times” decreased significantly.

Conclusions: The implementation of the nutrition education program led to positive changes in the knowledge, attitudes, and behaviors of the participants regarding sugar intake. Thus, conducting a nutritional education program and follow-ups for university students with a focus on sugar intake is meaningful for NCD prevention, and the effectiveness of this program proves that it can be applied to all. Following the implementation of the nutrition education program, NCD prevention is expected to improve as university students spread information regarding the same and play the role of information disseminators in their hometowns.

Keyword: Malaysia, Minum, Nutrition education, Sugar-sweetened beverage

PAB(T5)-31
The effects of the intervention by adding soy milk okara powder to the Young Woman

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Background and objectives: Recently, the dietary fiber(DF) intake of Japanese people has been decreasing. The reason is the decrease in intake of cereals, potatoes, legumes, vegetables and fruits. According to the Dietary Reference for Japanese, 2020, the daily target amount of DF for women over the age of eighteen is 18.0g or more. However, the intake of women in their twenties is 14.6g. Therefore, we conducted a crossover randomized trial study using soy milk okara powder to investigate the relationship between increased DF intake and defecation status in young women. **Methods**: The participants were young women volunteers(University students) aged 20 to 23 years. Twenty-one participants were divided into two groups, an intervention group (A:n=11) and a control group(B:n=10). We conducted a 9-week crossover randomized trial with and without soy milk okara powder(SMOP) added to the soup(pre-test:1w, First test:3w, washout:1w, next test(Exchange intervention and control) :3w, post-test:1w). The intervention group consumed about 3.0 g of fiber from SMOP per day for 3weeks. **Results**: The mean energy during the intervention of A was 1430.7 ± 268.1 kcal, and the energy during the control was 1330.2 ± 279.4 kcal. And, the energy of B during control was 1543.6 ± 318.0 kcal, and the energy during intervention was 1478.9 ± 328.5 kcal. The energy intake during the intervention study of B showed high overall results. The dietary fiber intake fluctuations (intervention・control) of A were 14.7 ± 5.0 g and 8.7 ± 5.0 g. The fluctuations in the intake of B dietary fiber (control・intervention) were 11.5 ± 3.9 g and 13.3 ± 5.1 g. Defecation volume was higher than before the intervention(=pre trial), but there was no significant difference between the two groups due to this intervention. **Conclusions**: It was suggested that nutrition education is necessary to actively take in DF-rich diets such as okara and encourage proper dietary intake.

Keyword: nutrition education, dietary fiber, soy milk okara powder, young women, crossover randomized trial study

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-32
Is there a relationship between unexplained complaints and skipping breakfast?

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Objectives:

Breakfast skipping is reported to have significant effect on unexplained complaints, particularly in adolescents, when lifestyle factors such as dietary habits are considered. This report aims to investigate the relationship between dietary intake and unexplained complaints related to breakfast by using data from dietary-intake status and health surveys of female college students.

Methods:

Between 2017-2019,172 female college students were surveyed regarding their daily diet, fats, carbohydrates, potassium, calcium, magnesium, iron, dietary fiber and salt. The data regarding food groups, habitual meal times, height, weight and Body mass index (BMI) were determined using a semi-quantitative food intake-frequency survey method (FFQW82). Additionally, the completed questionnaires of 114 individuals related to 24 unexplained complaints acquired in the spring of the same year were linked by ID and analyzed. The subjects were divided into a breakfast-skipping group (n=70) with a breakfast intake of <200 kcal, and a breakfast feeding group (n=102). A Mann-Whitney U test with a significance probability of <5% was used to compare the groups.

Results:

The energy and nutrient intake significantly differed between the groups when fat intake was excluded. The breakfast-skipping group had a higher cereal energy ratio and consumed less fish, soy products, and vegetables. Consequently, the intake of potassium, calcium, and magnesium in the breakfast-skipping group was reduced by nearly half. Moreover, each nutrient intake was below the reference ranges in both groups, and 18.8% of the breakfast-skipping group was classified as underweight based on BMI. Furthermore, there was no significant correlation between the frequency of unexplained complaints and nutrient intake, physique, or other factors.

Conclusions:

This study was unable to establish a significant correlation between dietary intake and unexplained complaints. While the relationship between diet and depression has been established, further focus is needed on the relationship between intake status and unexplained complaints.

Keyword: skipping breakfast, unexplained complaints, dietary habits, college students

PAB(T5)-33
Awareness and consumption of event foods among university students in Kochi Prefecture

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Background and purpose: Japanese food culture is characterized by the four seasons and geographical diversity, and is linked to traditional regional events and manners. The world-class characteristics of Japan's food culture have been gradually disappearing in recent years, due to the growing trend toward nuclear families, the weakening of regional ties, and the diversification of food. The purpose of this study was to investigate the awareness and consumption of traditional Japanese foods among university students and to examine the transmission of food culture. **Method**: A questionnaire survey was conducted among 75 university students in Kochi Prefecture. They were asked about their consumption of New Year's dishes (ozoni, osechi, toso sake, and Sawachi cuisine), their recognition of and experience with annual event foods, and their awareness of event foods. **Result**: New Year's dishes were *ozone* (93.2%), *osechi* (83.8%), Sawachi cuisine (60.8%), and *toso-shu* (8.1%). *Kamaboko* (fish cake) had the highest consumption rate at 77.3%, followed by *kuromame* (black soybeans) and herring egg. Vegetable dishes such as *nishime* and *namasu* were consumed by 17.3% and 25.3% of the respondents, respectively. Among the foods eaten for the five festivals, chirashizushi and *somen noodles* were eaten by 91.9% and 90.5% of the respondents, respectively, on Doll festival and Star festival. The edible chrysanthemum dish for Chrysanthemum Festival was quite low in both recognition and eating experience. Event foods were viewed by 87.8% of the respondents as a way to feel the seasons, 79.7% as a way to pass on culture, and 54.5% as a way to enjoy. There was a high level of awareness of the importance of passing on food events (91.9%). **Conclusion**: It was suggested that although the younger generation has a high awareness of the need to pass on food culture, they have little experience with food culture, so it is necessary to provide them with places and opportunities to learn about local foods and culture and gain experience in eating them.

Keyword: event food, New year's foods, zoni, food culture, nutrition education

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-34
Examination of nutrition education for collegiate athletes based on food education in home economics

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Background and objectives: The Basic Act on *Shokuiku* (Food and Nutrition Education) (2005) was enacted, and based on the Fourth Basic Plan for the Promotion of Shokuiku (2021), *Shokuiku* is being promoted in Japan. The government course [curriculum] guidelines were announced in 2017 for elementary and junior high schools and in 2018 for high schools. In the new curriculum guidelines, home economics should be considered to contribute to the enhancement of *Shokuiku*. Various issues have been reported regarding the food knowledge and eating habits of collegiate athletes. The purpose of this study was to examine the nutrition education necessary for collegiate athletes based on food education in home economics in elementary school, junior high school, and high school.

Methods: First, we investigated the learning objectives and content regarding food education in the curriculum guidelines for home economics at elementary, junior high, and high schools. Next, we investigated whether the issues and goals of the Fourth Basic Plan for the Promotion of Shokuiku are related to food education in the curricula. These results were compared with the content of nutrition education provided to collegiate athletes in eight sports discipline.

Results: In the curriculum guidelines for home economics, the systematization of food education among each school type was clarified, and the graduality was also recognized. Sports nutrition were listed as teaching items in high school. Among the goals in the the Fourth Basic Plan for the Promotion of Shokuiku , *shokuiku* promoted from the concept of "new normal" and sustainable food and nutrition, and nutrition education for prevention of lifestyle diseases were not specifically mentioned in the curricula. There were also not addressed in nutrition education for collegiate athletes.

Conclusions: Nutrition education for collegiate athletes should also take into account the perspective of *Shokuiku* that supports sustainable food and lifetime physical and mental health, which are not covered in home economics.

This study was conducted with academic research support from the Japan Dairy Association, the Milk Education Research Council

Keyword: collegiate athlete, home economics, nutrition education

PAB(T5)-35
Intervention study on health and dietary awareness among young women using the Line social media application

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Background and objectives: Young women in Japan tend to be thin, and there is a need to educate them about the importance of healthy eating for their future health. We examined the impact of providing information using the social media application (app) “Line” to improve health awareness and dietary awareness among young Japanese women.

Methods: We conducted a randomized controlled trial to examine the effects of the intervention. Participants were from one university and two junior colleges in Mie Prefecture. The intervention period was from September to October 2019. Using Line, we delivered content regarding appropriate weight and dietary balance and the correct intake and intake method of nutrients (calcium, iron, vitamin C, dietary fiber, potassium, salt, fat, saturated fatty acids, protein, and carbohydrates). Content was delivered twice a week for 2 months, for a total of 18 times. Self-related health and dietary awareness were assessed using a questionnaire, and nutrient and food group intakes were assessed using a simple self-administered dietary history questionnaire. Intention-to-treat analysis was conducted among 51 participants in the intervention group and 52 young women in the control group. To confirm the effectiveness of the intervention, we used the Wilcoxon signed rank test for within-group comparisons of continuous variables, the Mann-Whitney U test for between-group comparisons, the McNemar test for within-group comparisons of categorical variables, and the $\chi 2$ test for between-group comparisons.

Results: Compared with the control group, subjective health perception and subjective dietary fiber intake worsened in the intervention group whereas consumption of potatoes and other vegetables as well as dietary fiber intake increased significantly. Additionally, beverage consumption decreased and use of seasoning and spices increased.

Conclusions: Our findings suggested that providing information on health and food via a social media app over a 6-week period may lead to changes in health awareness and dietary awareness among young women.

Keyword: Social media application, Intervention study, Health awareness, Dietary awareness, Young women

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-36
Effects on energy intake and expenditure of ingesting low-calorie artificially-sweetened beverages in free-living healthy young women

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Background and Objectives: Many studies have investigated the immediate (short-term) and habitual (long-term) effects of artificial sweeteners on appetite and energy intake. However, it is not unclear that the middle-term effects of artificial sweeteners on energy balance (intake and expenditure) during daily life. The purpose of this study is to examine the effects on the energy intake (EI) and energy expenditure (EE) of the day and the next day of ingesting low-calorie artificially-sweetened beverage (ASB) and sugar-sweetened beverage (SSB) in free-living healthy young women.

Methods: Ten healthy young women (21.9 ± 0.6 years old, BMI = 21.0 ± 2.6 kg/m²) participated in a single-blind, randomized trial of 3-days experimental sessions, in which they were free to behave and eat as normal and record their all food intake (mobile phone photographs and text messages) and physical activity (Actigraph, AMI). On the 2nd day of each session, they were asked to ingest a bottled beverage (500 mL) with either low-calorie artificial sweetener or sugar. From the food records and physical activity data, the amounts of EI and EE were estimated for each day, and calculated the amount of EI and EE changes on the 2nd and 3rd days form the 1st day.

Results: For the EI changes, there were no significant effect of beverage (ASB or SSB) and day (2nd or 3rd) and no interaction between them. On the other hand, for the EE changes, there were no significant effect of beverage and day (2nd or 3rd) but a significant interaction between them: EE decreased on the day after ASB ingestion while increased on the day after SSB ingestion.

Conclusions: Our results demonstrated that the participants may have unconsciously reduced the amount of physical activity on the day after the ASB ingestion but increased it on the day after the SSB ingestion. This suggests that the benefits of using artificial sweeteners to reduce EI may be diminished by compensatory EE reduction on the next day.

Keyword: low-calorie artificial sweetener, energy intake, energy expenditure

PAB(T5)-37
A randomized controlled trial of slow eating using a smartphone-based educational program on mindful eating among young Japanese females

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Background and objectives: Mindful Eating (ME) is the practice of being fully aware of the food being consumed and how one eats. One element of ME is to eat slowly. Education that targets chewing behaviors and eating rates has been conventionally conducted, such as eating slowly and chewing 30 times per bite. However, the effects of education interventions using ME have not been investigated. Therefore, this study aimed to generate two intervention programs (focusing on 1) ME and 2) slow eating), and clarify the effects of these programs on the eating rate.

Methods: A randomized controlled trial was conducted on 66 female university students. Participants were randomly divided into the ME intervention group and the mastication intervention group. Each group participated in an 8-week program. Web-based questionnaire surveys were conducted before (B_X), at the end (A_0), one month (A_1), and three months after the intervention (A_3) on items related to basic attributes, eating rate assessed by the newly developed smartphone-based self-check tool, eating style, Mindful Eating Questionnaire (MEQ), and subjective diet-related quality of life (SDQOL). Within-group and between-group comparisons were made for each endpoint. Those who changed from undesirable to desirable situations were classified as "success," while the rest were classified as “non-success.”

Results: In both groups, eating rates at A_0, A_1, and A_3 were significantly lower than at B_X ($p < 0.001$), suggesting sustained improvement in terms of slow eating after interventions. The percentage of “success” at the end of the study was significantly higher in the ME group than in the mastication group regarding some items of the MEQ; "awareness of physiological and psychological experiences" ($p = 0.002$) and "awareness of external cues" ($p = 0.048$). Meanwhile, the percentage of "success" was significantly higher in the mastication group than in the ME group regarding the chewing period per bite ($p = 0.036$) and the number of chews per bite ($p = 0.013$).

Conclusions: Compared to the educational program focused only on mastication, the program focusing on ME showed not only similar improvement in terms of slow eating but also preferable changes in some items of the MEQ.

Keyword: Mindful Eating, Eating rate, Young adult female, RCT

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-38
Relationship of obesity with lifestyle and eating habits among Thai young adults

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Background and objectives: In Thailand, the proportion of the obese population has increased due to the improving income levels and the consumption of a westernized diet. Although obesity is also prevalent among young adults, only a few studies have evaluated the body type and health risks in young adults using a small sample size. In this study, we aimed to examine the differences in biomarkers, lifestyles, eating habits, and interest in dieting associated with bodyweight classification among young Thai adults; the survey was conducted over several years to obtain a sample size that is larger than that in previous studies.

Methods: The survey was administered to Thai university students residing in suburban Bangkok (Thanyaburi) and suburban Chiang Mai from 2017 to 2020 regarding their lifestyle and eating habits, using physical measurements and a questionnaire. A total of 207 male students and 507 female students were classified as “underweight,” “average weight,” “overweight,” or “obese” according to their BMI: these groups were compared in terms of their differences in biomarkers, lifestyle, and eating habits.

Results: Overall, 34.8% of men and 28.4% of women were overweight or obese. Students of both genders in the overweight and obese group had a higher body fat percentage and systolic/diastolic blood pressure (all P<0.0001). Overweight and obese group students were more interested in dieting (men: P=0.0007, women: P<0.0001), and most of them reported that they have dieted in the past (P=0.222, P<0.0001). Additionally, the obese group was more likely to report eating quickly (P=0.107, P=0.014).

Conclusions: The combined percentage of overweight or obese young adults in the study was as high as the adult population of Thailand. The higher mean systolic and diastolic blood pressures in the overweight and obese groups indicated that it is essential to address hypertension, a lifestyle-related disease, as soon as possible to prevent the development of cardiovascular and cerebrovascular diseases. Many participants with obesity were not currently dieting yet had previously been on a diet. We suggest that continuous weight loss intervention programs should be proposed to such individuals to help them maintain an appropriate weight and body composition.

Keyword: Obesity, Body weight, Lifestyle, Eating habits, Thai young adults

PAB(T5)-39
Consumer perception on processed fruit peels as dietary additives: a preliminary study on minimising fruit wastes

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Background and Objectives: Research has shown the role of healthy diets in the prevention of both chronic and infectious diseases. With the current increase in the occurrence of non-communicable diseases (NCDs), people need to make healthy food choices. This study aimed at generating data on consumer fruit peel preferences, food choice motives and consumer perception of product quality to enable the design and production of acceptable processed fruit peel sprinkles which will be used as food additives. The objectives of this research include: to ascertain consumers' acceptance of new products (dried, powdered fruit peels) and to determine the most preferred fruits and flavours.

Methods: An online questionnaire was used for this cross-sectional survey carried out in South Africa. The questionnaire link was circulated in the different provinces for 4 weeks (June 2021); it was structured to gather socio-economic data, nutrition knowledge, overall perception/acceptance of processed fruit peel products by the respondents and factors that influence consumer choices. Descriptive statistics were used in the statistical analyses.

Results: The surveyed population consisted of 517 participants from the nine South African provinces with Gauteng, North West and KwaZulu-Natal accounting for over 70% responses. About 70% of the participants also had a tertiary education and most of the participants showed good nutrition knowledge (85%); they were aware that fruit peels contain useful micronutrients and antioxidants which promote good health and can also assist in weight loss (67%). ‘Sweetened' (36%) was the most suggested flavor for the proposed product, followed by ‘Natural' i.e. no flavor additives (24%) and ‘Chilli' (11%). About 90% of the participants were interested in learning how to process the fruit peels for consumption purposes.

Conclusion: Consumers showed keen interest in the consumption of processed fruit peels, with demand for citrus fruit peel products being the highest. Processing and consumption of fruit peels should be encouraged and promoted in order to strengthen the immune system especially during this pandemic, with the reduction of fruit wastes being a key target.

Keyword: Consumer, Perception, Fruit peels, Dietary additives, Minimising waste

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-40

Relationship between milk intake behavior and health literacy during the adulthood - Current situation and issues in Japan and Korea-

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Background and objectives: Health literacy, defined as "an ability to inform health-related decisions" is one of the issues that attracts attention in the field of health education. The health literacy of Japanese people is known to be lower than that of European and other Asian nations. Insufficient calcium intake is a health issue that can affect elderly persons. Milk intake is one of the primary sources of calcium in the adulthood. We aimed to explore the relationship between milk intake behavior and health literacy and identify the differences in the relationship between Japan and Korea.

Methods: This was a cross-sectional study performed as an international joint research in Japan and Korea. The study period was April 2019 to March 2020. The participants were adults over the age of 18 in Kyoto, Shiga, and Shimane, Japan, and in Daegu, Korea. We distributed the modified Health Literacy Survey (m-HLS-14) and Brief-type Self-administered Diet History Questionnaire (BDHQ) among all the participants. We employed correlation coefficient to explore the factors related to milk intake behavior. Test and analyses were performed using JMP14 software.

Results: The number of participants were 464 in Japan and 76 in Korea (response rate 64.4%). The participants who answered that they drink milk every day and their age factors correlated negatively in Japan (r= -0.22; p< 0.0001) and in Korea (r= -0.32; p= 0.005). And the participants who answered that they drink milk every day and their gender difference factors correlated positively in Japan (r= 0.03; p= 0.53) and in Korea (r= 0.08; p= 0.50). The participants who answered that they drink milk every day and Body Mass Index factors correlated negatively in Japan (r= -0.06; p= 0.27) and correlated positively in Korea (r= 0.02; p= 0.86). In the item about an ability to inform health-related decisions, the number of the participants who answered that they would not do anything is 100 (23.9%) in Japan and 15 (19.7%) in Korea.

Conclusions: Milk intake behavior correlated with increasing ages in both of Japan and Korea. We need to develop health literacy to obtain essential nutrients for during the adulthood.

Keyword: milk intake behavior, health literacy, adulthood, Japan and Korea

PAB(T5)-41

Joint Activities by Universities for the Improvement of Improving Lifestyle Habits of Community-residing Adults: Influence of the Number of Times Participating on Food Preferences and Lifestyle Improvement

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Background and objectives: A joint project for improving the lifestyle habits of local residents in Kitakyushu City, Fukuoka, Japan was implemented in 2014. The activities of this project consisted of extension lectures for lifestyle-related diseases alongside a meal prepared considering the characteristics of the disease. While promoting dietary education activities for local residents, students were also encouraged to positively engage in the activities as a type of participatory education.

Methods: The project was carried out for six years from 2014 to 2019. More than 90% of the participants were over the age of 60, and the number of participants gradually increased during the project period. To assess the program, we used the results of a questionnaire to examine the effects of different numbers of time participating in this course on food preferences and lifestyle-related improvement.

Results: A total of 1,516 valid responses were collected. The respondents were divided into 4 groups according to the number of times they participated in the course (out of a possible 23)—1 time (15.1%), 2 to 5 times (46.6%), 6 to 9 times (28.8%), and 10 or more times (9.5%). The group with 10 or more participations had a higher percentage of respondents who answered "very healthy" than the other groups, and the percentage of people practicing healthy eating habits was also high in this group. In addition, more than 80% of the participants were repeaters.

Conclusions: This project helped participants interact and raise awareness of health promotion. Because several individuals have participated in multiple activities within this project, their degree of understanding of the lectures was high and their lifestyles were improved. This project has proved to be effective and engaging. Future research is needed to create health awareness and improve lifestyles in the local community.

Keyword: cooperation of universities, extension lectures, providing a meal, improvement of lifestyle habits, community-residing adults

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-42

Meal preparation characteristics of Japanese elderly people: A preliminary study of the elderly living alone.

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Background and Objectives: Weight loss and poor-quality diets are some of the factors associated with frailty in the elderly. Consuming a variety of foods is essential for a balanced diet. Food intake requires skills in food preparation, such as cooking. Women are more skilled in meal preparation, while men face challenges due to social norms. This study aimed to clarify the characteristics of meal preparation among Japanese elderly who consume a variety of foods.

Methods: The participants were 133 community-dwelling elderly adults aged 62-88 living alone in City A, Saitama Prefecture. Participants photographed and recorded all food and drinks they ate for three non-consecutive days in September 2013. A total of 7,035 dishes and foods were observed. These were divided into the following four categories: ″ homemade, ″ ″ re-cooked dishes bought outside,″ ″ prepared outside the home,″ and ″ eating out.″ Cooking methods were classified into 20 patterns based on previous studies. Participants were grouped according to the Dietary Variety Score (DVS), a 10-point scale, one of the indicators of diversity of food intake among the elderly in Japan: low DVS group (3 points or less) and high DVS group (4 points or more). Unpaired t-test and Mann-Whitney's U-test were performed by gender and DVS group.

Results: Women had more dishes per person per day ($p=0.010$) and were ¨homemade¨ ($p<0.001$) than men. For men, the high DVS group ate more dishes per person per day than the low DVS group (19.76 ± 3.9 vs. 15.35 ± 4.2, $p<0.001$). The number of ¨homemade¨ dishes were higher in the men high DVS group than the men low DVS group (17.27 ± 2.5 vs. 12.36 ± 2.6, $p<0.001$). No significant differences were found among women between DVS groups. The most frequently occurring homemade cooking methods for both men and women were marinated and salads for vegetables and grilling or stew for seafood and meat. There were no differences in frequent cooking methods between the two genders.

Conclusions: The men high DVS group had more homemade meals than the low DVS group. Cooking methods did not differ between genders.

Keyword: elderly adults, meal preparation, cooking, food variety

PAB(T5)-43

Aim to Provide Meals for Events at a Nursing Home During the COVID-19 Pandemic Situation

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Background and objectives: A nursing home in Japan provides event meals in addition to regular meals in order to increase the satisfaction of residents. Unlike the regular meal basis, when serving meals, it is best to have a buffet style for the residents and nursing home staff. It allows comfortable conversations over a wonderful buffet style meal. However, it changed the style of how people eat during the COVID-19 pandemic. We must practice social distancing and keep quiet while eating. So, we plan to conduct a good dining event. It will help create good conversations and provide enjoyable meals for everyone.

Methods: When serving meals, we observe the residents and how they eat their food. We think of ways to make meals more exciting and appealing to them. We usually serve a set meal (rice or bread, main dish, side dish and soup). Moreover, we plan to eat quietly instead of buffet style with a good ambiance for a better dining experience.

Results: We had no choice but to use disposable containers because of the COVID-19 pandemic situation. Shokado bento boxes (Japanese traditional style lunch box) are sometimes served at event meals. They are served in a disposable shokado bento containers. The residents enjoyed their meal.The fish will be cooked on the spot. It was grilled in shichirin (portable brazier) and served. We usually use fish fillets, but we used a whole one for the event meals. It is better to grill a whole fish than fillet. The fragrance of the whole fish is appetizing. Residents who find it difficult to swallow can eat the fish while being careful. We devised a way to make the food more appetizing and fragrant.

Conclusions: A silent eating style would continue for a while in the COVID-19 pandemic situation. We would devise a good ambiance for people to enjoy during their meals while having good conversation with others. The measurement of meal satisfaction of residents is necessary. For care home residents, mealtimes can be even more important.

Keyword: Nursing home, Event meals, COVID-19, Satisfaction of residents, Silent eating

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-44
The importance of instructions on proper hydration during cheerleading practices

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Background and objectives: In Japan, the Heat Illness Prevention Guidebook contains hydration guidelines formulated by the Japan Sports Association. The guidelines are not provided on the website of the Foundation of Japan Cheerleading Association. In contrast, hydration guidelines are provided on the websites of several other sporting associations in Japan. There have been situations where coaches of high-performance clubs have concentrated on technical guidance, but not on sufficient hydration. This study explored the relationship between hydration instructions and cheerleading performance.

Methods: In this study, 116 coaches of junior schools, junior high schools, high schools, and universities that entered the 2021 Kanto cheerleading competition were enrolled. The coaches completed a questionnaire-based survey that elicited responses concerning practice environment, length of practice, hydration guidance information and type of hydration fluid. The high-performance group included teams that qualified for the semifinals of the Japan Championships in the division1 free-acting category of the 2016–2021 Kanto cheerleading competition (HHG: junior high schools, high schools, and high-performance group (n=11); HJG: junior high-performance group(n=2)). Other teams comprised the low-performance group (LHG: junior high schools, high schools, and low-performance group (n=21); LJG: junior low-performance group (n=5)). In the analysis, the questions were cross-aggregated using competitive power for each school type, and the χ^2 test was performed.

Results: The coaches of the junior schools provided instructions on proper hydration techniques regardless of their performance group. On the other hand, HHG coaches did not usually provide proper hydration instructions, compared with LHG coaches (p=0.044). HHG coaches were significantly less likely to provide instructions concerning daily oral ingestion of NaCl (p=0.05) and carbohydrate (p=0.049). LJG coaches were significantly more likely to provide instructions to ingest carbohydrate based on the length of the exercise (p=0.008). Regardless of school type and performance, coaches did not measure the weight of the athletes before and after practice to ensure proper hydration during practice, and did not recognize the types of fluid ingested.

Conclusions: HJG and LJG coaches instructed their athletes on proper hydration techniques. LHG coaches were better than HHG coaches in delivering instructions on hydration techniques.

Keyword: Hydration, Cheerleading, Athletic club activity, Coaching, Performance

Further Collaborators: Foundation of Japan Cheerleading Association

PAB(T5)-45
Associations of a balanced diet combining staple food, main dish, and side dish and with eating behavioral outcome expectations and self-efficacy in adolescent and young adult athletes.

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Background and objectives: In Japan, a healthy dietary balance is recommended to eating balanced diet with staple food, main dish and side dish. It is also important for athletes with high physical activity levels to take such a recommended dietary behavior. This study identified balanced dietary behaviors and related predisposing factors that should be focused on as pre-assessment items when implementing nutrition education for adolescent and young adult athletes at the national competition level.

Methods: The participants were adolescents and young adults designated as candidates for the 2016-2020 National Sports Festival and targeted for nutrition education support (14-18 years: 104 males, 43 females; 19-28 years: 15 males, 19 females). A self-administered questionnaire was used to assess frequency of intake of staple foods, main dishes, and side dishes, outcome expectations (OE) and self-efficacy (SE) for eating behaviors, and other health behaviors. In the analysis, the dependent variable was defined as eating a combination of staple meal, main dish, and side dish at least twice a day (favorable level), the independent variables were OE, SE, and health behaviors, and the adjustment variables were sex and age. A series of binary logistic regression analysis were performed to calculate adjusted odds ratios (AORs) and 95% confidence intervals (CIs).

Results: One hundred and seven respondents (59.1%) met the favorable level. Taking this balanced dietary behavior was significantly associated with OE (AOR = 2.63, 95% CI: 1.05-6.59) and SE (AOR = 2.55, 95% CI: 1.30-5.02) of " eating a enough staple meal (rice)", OE (AOR = 3.55, 95% CI: 1.61-7.83) and SE (AOR = 2.47, 95% CI: 1.28-4.77) of "eating a complete meal with staple food, main dish and side dish at every meal", OE (AOR = 2.82, 95% CI: 1.46-5.46) and SE (AOR = 3.13, 95% CI: 1.58-6.19) of "eating a side dish with every meal". It also showed an association with weight measurement habits (AOR = 2.09, 95% CI: 1.09-4.00).

Conclusion: In nutrition education for the athlete during adolescence and young adulthood, goal setting that encourages staple food and side dish intake behaviors may be effective.

Keyword: adolescence and young adults, athletes, Japanese-style diet, staple food, side dishes

PAB(T5)-46
Relationship between cooking techniques and refrigerator foods among female college athletes living alone

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Background and objectives: For each residence, correlations between total refrigerated foods and cooking techniques were analyzed. College students living alone have difficulty enriching their meals. Female college athletes living alone spend longer on sports, thus cook less. However, cooking skills can help prepare quicker low-priced, nutritionally balanced meals, thus reducing refrigerated food loss. Therefore, we clarified the relationship between refrigerated food and cooking techniques of female college athletes.

Methods: Participants were all J university students (n=294) receiving introductory nutrition. We conducted a survey using Google Forms; subsequently, 112 respondents were examined. Questions were regarding living style, exercise habits, refrigerated foods (37 kinds of vegetables, 46 kinds of seasonings, 15 kinds of foods other than seasonings and vegetables), cooking techniques, and knowledge of sustainable development goals. To clarify living-alone characteristics, the chi-square test was performed after cross-tabulation of living style and each question item. Living style results were as follows: living alone, (n=13); living with family, (n=74); and living in a dormitory, (n=25). One-way ANOVA was performed for lifestyle and refrigerator capacity analyses.

Results: The refrigerator's capacity was not significantly different for those living alone (190.4±136.6 L) and living in a dormitory but was significantly smaller among those living at home (p<0.001). Considering refrigerated foods, 23/37 of vegetables (62.2%), 24/46 of seasonings (53.2%), and 2/15 of seasonings and non-vegetables (13.3%) were present. There was no significant difference between the three groups regarding spoiled or expired food, except tofu. All people living alone answered that there were no spoiled vegetables (p=0.002). This study revealed that those with cooking skills know the relationship between food and seasonings. For those living alone, great cooking ability positively correlated with the presence of refrigerated vegetables (r=0.204 ns), seasonings (r=0.412 ns), and non-vegetables/seasonings (r=0.563, p<0.05).

Conclusions: Female college athletes living alone or in dormitories have a smaller refrigerator capacity. However, they store about half the amount of food as those living with families. Those living alone did not have spoiled vegetables, and those with high cooking skills stored numerous foods. Therefore, female college athletes could reduce food loss by improving their cooking skills.

Keyword: food loss, refrigerator, college student-athlete living alone, cooking skill

PAB(T5)-47
A study on food education for female college athletes using “Edo Tokyo traditional vegetables"

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Background and objectives: At 212.1g/day, Japanese women in their 20s consume fewer vegetables than other age groups. While food education is conducted targeting all generations, there is little data regarding the vegetable intake of female college athletes. "Edo Tokyo traditional vegetables" has been a success in Tokyo's vegetable culture since the Edo period. This study examined whether there is a relationship between the experience of eating "Edo Tokyo traditional vegetables," and the vegetable eating habit.

Methods: The study participants were 44 female college athletes enrolled in March 2021. As part of their food education, the participants ate lunch containing “Edo Tokyo traditional vegetables,” attended a lecture on it, and answered various questions. A French chef devised and cooked their lunch according to a Japanese food guide: the grain dishes were 2.5 SV, vegetable dishes were 4 SV, and the fish and meat dishes were 2 SV. The study analyzed cross-aggregated questions using the relationship between likes and dislikes regarding vegetables, vegetable intake habits, participation in food education, and the χ^2 test.

Results: All those interested in food were vegetable lovers (LVG n=36), while the percentage of vegetable haters (HVG n=8) was 37.5% (p= 0.004). There was a significant difference in food education participation (p=0.013), with many LVG participants, but only two HVG participants. While all participants attempted to consume vegetables (p=0.818), the percentage of eating vegetables more than once a day was different, with LVG at 72.2% compared to HVG at 0.0% (p<0.001). There were few leftovers of the radish boiled in red wine, and stir-fried meat and burdock, with some 95% of respondents wanting to eat it again; 55.2% of the marinated vegetables became leftovers, and 37.9% of participants wanted to eat them again.

Conclusions: The study found that a taste for vegetables is associated with interest in food and participation in food education, but not with the willingness to eat vegetables. Even if they do not actively encourage vegetable intake, novel foods may encourage better food practices by eating in the usual way of cooking.

Keyword: vegetable eating habit, food education, university students

Further Collaborators: Michishige Ohtake, Edo Tokyo traditional vegetables research society

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-48
FFQ for Food consumption pattern among pre diabetic women in a rural community of north India

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Background and Objectives Non communicable diseases are on increase in India mainly attributable to improper diet and life styles. People are moving away from traditional diet towards more refined diet. This nutrition transition is largely responsible for various life styles related non communicable diseases. The study aimed at describing the food consumption patterns in a sample of pre diabetic women residing in rural area of north India. **Methods** A cross sectional study was done in the field practice area of All India Institute of Medical Sciences, New Delhi. A pre validated, pretested, 29 item, food frequency questionnaire was applied to assess the food consumption pattern of 116 participants. **Results** The mean age of the participants was 47 years with a standard deviation of 7.5 years. Whole wheat flour was consumed by all participants. Refined flour, rice and broken wheat and bread was reported to be consumed occasionally by most of the participants. Buffalo milk was reported to be consumed daily by more than 80 percent of the participants, Chicken, egg, fish and other animal products like mutton and pork etc were reported to be consumed never by most of the participants. **Conclusion** Food frequency questionnaire could be a simple way to know about preferred consumption pattern. Based on preferred or consumed food items, proper diet chart can be prepared which is best suited for the community based on their dietary habits. Based on this nutritional and health education material for the community or individual can be developed and all this material along with results of this study can be utilized to prepare these charts for rural north India to deal with non communicable diseases through right kind of dietary practices

Keyword: Food frequency questionnaire, non-communicable

Conflict of Interest Disclosure: none

Further Collaborators: none disease, rural, pre diabetic, women

PAB(T5)-49
Do people with hypertension or diabetes change their processed food consumption behaviour?

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Background and objectives: In Bangladesh, morbidities and mortalities related to non-communicable diseases (NCD) have increased several folds during the recent decades. Dietary management of a patient with hypertension or diabetes is important for the prevention of complications and maintenance of a healthy life. In this study, we aimed to understand whether people with diabetes and hypertension change processed food consumption practices. Methods: We analyzed data from Bangladesh Food Security and Nutrition Surveillance round 2018-19. In this study, data were collected from 82 randomly selected clusters covering rural, non-slum urban, and slums areas in all eight administrative divisions of Bangladesh. We interviewed 20-59 years old women and men about their diabetes and hypertension status. Processed foods comprised savory and fried snacks, sugary snacks and sugar-sweetened beverages. The weighted prevalence of self-reported hypertension and diabetes was estimated. Two-sided t-test was done to see the statistical significance of the mean differences in the weekly frequency of consumption of processed foods. Results: A total of 9986 adults aged 20-59 years were included in this analysis. The weighted prevalence of self-reported hypertension was 16.3% (95% CI: 14.7, 18.1) and self-reported diabetes was 4.9% (95% CI: 4.0, 5.9). The mean weekly frequency of consumption of savory and fried snacks, sugary snacks and sugar-sweetened beverages among hypertensives were 2.91, 5.17 and 13.38 times, respectively. The mean weekly frequency of consumption of savory and fried snacks was lower among known hypertensives compared people who were normotensive or did not know their status. The mean weekly frequencies of consumption of savory and fried snacks, sugary snacks and sugar sweetened beverages among diabetics were 2.91, 6.28 and 13.38 times, respectively. The weekly frequency of consumption of savory and fried snacks and sugar sweetened beverages were lower in known diabetics but the weekly frequency of consumption of sweet snacks was higher. **Conclusions**: Processed food consumption practices of known diabetics and hypertensives were different from people without diabetes or hypertension but still harmful. The Ministry of Health and Family Welfare in Bangladesh should consider this while designing and implementing health programs for diabetics and hypertensives.

Keyword: processed food , hypertension , diabetes , Bangladesh

Keyword: collegiate athletes, nutrition, nutrition education, eating habits, dietary behavior

PAB(T5)-50
Evaluation of nutrient intakes, dietary practices, and interests of nutrition education among Japanese collegiate baseball players

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Background and objectives: Collegiate athletes believe that good nutrition will improve their performance. Recently, more attention has been devoted to the nutritional intake of collegiate baseball players. Some studies have addressed the need for the development and implementation of nutrition education program for these athletes. This study aimed to evaluate the nutrient intakes, dietary practices, and interests of receiving nutrition education lessons among collegiate baseball players.

Methods: Forty-seven Japanese male baseball players (age, 20.7±1.4years; height, 173.1±4.9cm; body weight, 69.6±7.5kg, BMI 23.2±1.9kg/m^2) participated voluntarily in this study. Nutrient intakes were determined by Food Frequency Questionnaire. All participants answered dietary practice questions (e.g., nutritional supplements usage, interests of particular nutrients, etc.). They were also asked to give the researchers their feedbacks about the nutrition educations lessons they have received for the 3-month. Readiness to improve dietary practice was measured using one question with five response options that corresponded with the stage of change construct of the Transtheoretical Model of Behavior change.

Results: Average daily energy, protein, fat, and carbohydrate consumptions were 3042±792kcal, 127±43g, 96±25g, 399±113g, respectively. The dietary assessment showed an adequate intake of calories, vitamins, and mineral, except for calcium (742.3±319.1mg) and dietary fiber (14.1±4.9g), for which most of the participants did not reach the recommendations. Sixty-two% of players regularly consumed nutritional supplements, such as protein powder, branched-chain amino acids. After receiving the nutrition lessons, more than 85% of players responded that they were interested in learning about sports nutrition. Younger college students (i.e., freshman, sophomore), particularly for those living away from the family home were interested in learning about food preparations, cooking, and grocery shopping. Readiness to change their dietary behavior (Contemplation and preparation stages) was observed more than 54% of players. Increase muscle strength and body size, and recovery strategies were the reasons for their food choices.

Conclusions: Collegiates baseball players had lower calcium and dietary fiber than recommended levels. The results of this study suggest that collegiate baseball players could benefits from basic nutrition education. Successful sport nutrition program requires an understanding of the needs and various life factors faced by collegiate athletes.

PAB(T5)-51
Nutritional status and protein supplement use in collegiate male lacrosse athletes

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Background and objectives: A proper diet enhances an athlete's overall health status. It has been reported that many athletes had inadequate energy intake and nutrient needs. However, dietary intakes and supplement use in Japanese collegiate male lacrosse athletes remains largely unexplored.The aim of this study was to evaluate the body composition, dietary intake, and use of protein supplements of Japanese collegiate male lacrosse athletes.

Methods: Twenty-nine male lacrosse athletes (mean ± SD; age:20.97±0.90 y; height:172.2 ± 4.5cm; body mass:66.8 ± 5.8 kg; %body fat:14.5 ± 4.1%) participated in the study. Body composition was measured through multifrequency bioelectrical impedance analysis (InBody 770). Food intakeswere analyzed through four-day food records (three practice days and one day off from practice). Athletes were asked to take pictures of the foods, beverages and supplements, reporting names of foods, brand name of all dietary supplement products and sending these to a project dietitian. Daily average values were calculated for total energy, protein, carbohydrate, and fat intakes and compared to theDietary Reference Intakes for Japanese – physical activity level III (Ministry of Health, Labour and Welfare, 2020). All participants answered a questionnaire about their use of nutritional/protein supplements and interests of learning about balanced diets.

Results: Analysis of food intakes between practice days and off days shows significant more intakes of energy and carbohydrate during practice days ($p<0.005$). However, the athletes consumed significantly less than recommended values for energy (2384±387 kcal vs. 3050 kcal) and carbohydrates (338±76g vs. 381g) ($p<0.005$). Athletes consumed significantly more protein than recommended (78±12g vs. 65g) from food items ($p<0.001$), which was not included their intake of protein supplements (approximately 20g/day). All athletes reported habitual protein supplements use (>2days/week over the past year). 76% of the collegiate male lacrosse athletes were interested in learning about balanced diets.

Conclusions: Results of the study suggest that collegiate athletes had insufficient total energy and carbohydrate intakes but consumed more protein than recommended. The athletes could benefit from basic nutrition education that promotes a

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

balanced intake and provide optimal amounts of all nutrientsin daily diets.

Keyword: nutrition, calories, males, athletes, supplements
Conflict of Interest Disclosure: None
Further Collaborators: Non

PAB(T5)-52
How do para-athletes perceive their diet and dietitians? a pilot study based on interview survey

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Background and objectives: Nutritional support for para-athletes (PAs) lags athletes without disabilities. At present, there is very little guideline that dietitians can refer to when supporting them. In addition, various dietary problems caused by individually different types of disabilities make nutritional support for them difficult. The aim of the study was to elucidate how PAs perceive their diet and dietitians and explore clues for effective measures that would help them practice evidence-based sports nutrition.

Methods: Six active elite PAs (30 – 70 yrs., 4 males) with lower-limb disabilities who participated in the international wheelchair sports competitions (tennis, softball and table tennis, with 2 – 26 years of player history), and a female boccia trainer without physical disability were surveyed through semi-structured interviews on the ideal diet for improving competitive performance, evaluation of their typical diets, and role of the dietitian as a supporter. Responses obtained from participants were analyzed using quantitative content analysis by language analysis software (NTT Data Mathematical Systems, Tokyo, Japan).

Results: There are differences in the ideal diet based on the characteristics of the sport, but most participants believed that a nutritionally well-balanced diet with abundant vegetable was ideal for improving competitive performance. PAs who use wheelchair daily pay attention to their total calorie intake, because gaining weight is a critical issue for operating their wheelchair and transferring themselves into their wheelchair. Despite their high competition levels, none of them received routine dietary advice from dietitians. Some participants did not even feel the need to engage with dietitians.

Conclusions: Even for para-athletes at a high level of competition, the "ideal diet" they consider is not always the optimal diet for improving their competitive performance. In addition, there are various barriers to practice their optimal diet due to disability characteristics. Dietitians need to understand these barriers, their worries and conflicts and to act to help them practice sports nutrition. Thus, there remains a lot of room for providing nutritional supports for PAs. This is a truly new field of study how qualified nutritionists, medical and exercise practitioners in para-sports can support PAs by “power of nutrition”.

Keyword: interview survey, sports nutrition, dietary supports, wheelchair sports, dietitians

PAB(T5)-53
Qualitative research on the support required to promote physical activity among people with visual impairments

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Background and objectives: People with visual impairments are at a higher risk of chronic diseases compared to those who are non-visually impaired. Hence, it is important for them to make efforts to improve their health. It has been reported that few people who are visually impaired achieve the recommended amount of physical activity (PA), a pillar of health promotion. Hence, combined efforts are required to promote PA among them. The purpose of this study is to summarize the implementation to promote PA and the support they considered necessary in terms at the level of intrapersonal, interpersonal, and community factors, and to identify these characteristics among people with visual impairments. Methods: Ten people with visual impairments in their 30s~50s living in Japan participated in focus group interviews in September 2021.The interview items were: ① how PA would be secured and ② support required to perform PA. The transcripts was transcribed verbatim and written data was delimited for each single content. For each piece of delimited information, the content was summarized in concise and appropriate codes. Categories were created based on the codes collected for similar content. Results: ① Devices for the implementation of PA were grouped into nine categories. Of these, six items corresponded to intrapersonal factors, two to interpersonal factors, and one to community factors. ② Support required for the implementation of PA was grouped into 15 categories. Of these, one item corresponded to intrapersonal factors, three to interpersonal factors, seven to community factors, and four to access to information. Conclusions: Many items from the “intrapersonal level” were mentioned for innovations towards the implementation of PA. In addition, many items from the “community levels and access to information” were mentioned for necessary support. The results suggest the importance of creating a community where individuals can share their innovations and skills and the creation and dissemination of a guide for sports facility staff. In addition, health promotion programs are required to provide the necessary information.

Keyword: Visual impairment, physical activity, intrapersonal factors, environmental factors, health promotion

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-54
Examination of a cooking education program for nutrition and home economics student teachers

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Background and objectives: Poor culinary skills are often a source of anxiety for students who aspire to become nutrition and home economics teachers. This study was thus conducted to examine the effectiveness of a program designed to improve the home cooking skills of students who are preparing to become nutrition and home economics teachers.

Methods: The participants consisted of 24 second-year teacher trainee students studying nutrition and home economics in a women's university. They participated in this program during 2021-2022, with prior consent. A flipped learning program was conducted on “Cooking sardine kabayaki” based on Japanese junior high school home economics textbooks. The practical training contents and cooking video were shown to the students one week in advance, and the cooking practice was conducted on the same day of the training. A questionnaire was administered to the participants “before” and “after” they watched a video on teaching cooking to students who aspire to be nutrition and home economics teachers. In addition to the “experience of handling sardines in the past” before the training, the participants were asked about their “level of confidence in teaching others” before and after the training. After the training, they were also following: “How many times have you watched the flipped learning video” and “What are your impressions of the video”. The analysis was conducted using SPSS 26.0 for the quantitative survey and KH coder for the qualitative survey.

Results: The average age of the respondents was 20.1±0.9years. Only two students answered “I can teach others on cooking practices” prior to the survey. After the flipped learning program, 12 more students responded that they felt confident about educating others on cooking practices ($p<0.05$). Those who responded, “cannot teach” tended to watch more videos than those who responded, “can teach”. Many participants have commented that they felt positive about the training, including that it gave them confidence in their ability to teach. This program thus provided participants with confidence in their ability to teach others.

Conclusions: This program is considered useful for participants.

Keyword: flipped learning, nutrition student teachers, home economics student teachers, cooking practice

PAB(T5)-55
Correlation between holding chopsticks correctly and consumption of fish dishes among childcare students

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Background and objectives: Since ancient times, the appropriate use of chopsticks has been part of a dietary etiquette in Japan, and its knowledge is an important theme of dietary education. Okayama prefecture, connected with the Seto Inland Sea, specializes in many local fish and shellfish dishes; for this reason, students who could hold chopsticks correctly were believed to consume fish items frequently. This study aimed to investigate the correlation between the correct manner of holding chopsticks and the intake of fish dishes among childcare students.

Methods: The study included 234 first to fourth grade students enrolled in a nursery school in Okayama prefecture. A questionnaire method was employed to examine how chopsticks were held and how fish dishes were consumed. We asked the students to choose the appropriate method to hold chopsticks from the question items created using figures in the survey form. The frequency of fish consumption included the intake of fish dishes for a week. Accordingly, 10 items were evaluated on a 5-point scale to gauge what type of dietary form was common when consuming fish. Using the SPSS Statistics Version23 (manufactured by IBM), cross tabulation was performed on how to hold chopsticks and the consumption of fish items, and analyzed using the χ-square test.

Results: Approximately 60% of respondents followed the correct method of holding chopsticks. No association was found between how the participants held their chopsticks and the consumption of fish dishes.

Conclusions: Although there was no association between how to the chopsticks were held and the consumption of fish dishes, the manner in which childcare students involved in children's dietary education learn to hold chopsticks correctly influences culture. The percentage of people who consumed fish dishes such as sashimi and sushi, which can be obtained anywhere in the country, was higher than those who consumed rose sushi and mamakari, which are local dishes.

Keyword: chopsticks, childcare students, fish dishes

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-56

The relationship between food and nutrition education provided by nutrition teachers and students' eating habits

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Background and objectives: In Japan, the assignment of nutrition teachers to elementary and junior high schools began in 2005 against the backdrop of the Nutrition Education Basic Law. We conducted this study to understand the current status of nutrition education promotion in schools and students' dietary habits and to clarify the results of the assignment of nutrition teachers.

Methods: A self-administered questionnaire survey was conducted on the content of nutrition education implemented in elementary schools to which nutrition teachers belong and in one class of the sixth grade of elementary school, resulting in 1,373 schools with nutrition teachers. Student responses were averaged for each school and used as school data. Statistical analysis was conducted using the Mann-Whitney U test and the Kruskal-Wallis test.

Results: We classified the food-related instructions into three categories: academic subjects, mealtime instruction, and information provision. Children who received a combination of the three types of instruction were more aware of the importance of breakfast consumption and the inheritance of local cuisine than those who received only one kind of instruction (p=0.015 and p=0.006) and who received information provision (p=0.022 and p=0.018). The children's breakfast intake and efforts to pass on local cuisine were higher in the combination of three types (p=0.018 and p=0.013) than in a kind of instructions, and breakfast intake was higher than information provision alone (p=0.050). Children's perception of the importance of breakfast consumption was influenced by lunchtime instruction (p=0.009), and the inheritance of local cuisine was influenced by the school subjects and lunchtime instruction (p=0.002 and p=0.009). The children's efforts in passing on local cuisine were affected by the teaching of subjects (p=0.001).

Conclusion: It was considered adequate to combine academic subjects and mealtime instruction and information provision to increase students' breakfast intake and raise their awareness of the importance and inheritance of local cuisine in elementary school.

Keyword: Nutrition teacher, Food and nutrition education, Elementary school

PAB(T5)-57

Survey on Current Status of Education and Academic-Industrial Partnerships at Dietitian Training Universities in Vietnam Second report: Consideration of industry-academia collaboration in the food service field

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Background and Objectives: This is the second report following a survey of the current state of the educational environment and academic–industrial partnerships at dietitian training universities in Vietnam. Based on the current situation of academic–industrial partnerships in the field of food service at dietitian training universities, we considered how Japan might contribute to training dietitians in Vietnam.

Methods: TThe survey was targeted to 20 universities that have, or are planning to offer, dietitian training courses in Vietnam. The content of the survey included the educational curriculum, educational status, and current situation of academic–industrial partnerships. In February 2022, a joint briefing session was held online with the National Institute of Nutrition in Vietnam and a questionnaire was sent out. The respondents were department chairs of each university and full-time faculty members.

Results: Responses were received from 18 universities (90% response rate), including 12 of the 13 existing universities and 6 of the 7 universities scheduled to open. Among the 12 existing universities, only 5 (42%) had educational programs related to the management of food service facilities, and few provided training in cooking or education on food service management or quality management. Ten universities currently have partnerships with corporations, and 7 of them are collaborating with overseas partners. Regarding expectations for academic–industrial partnerships with Japan, the most frequent responses were “human resource development of students through internships and studying abroad” and “investment in educational facilities and food service facilities” (16 universities, 89%). As many as 14 schools (78%) chose the responses “research activities” and “education on nutrition and diet”.

Conclusions: More than half of Vietnam's dietitian training universities are promoting academic–industrial partnerships, and there are high expectations for these partnerships, especially those with Japan, including financial support for human resource development and capital investment. At present, many of the universities do not offer education on the management of food service facilities; thus, it is necessary to consider providing educational programs on food service operations at facilities such as hospitals and corporate cafeterias as part of Japan's contribution to training dietitians in Vietnam.

Keyword: Dietitian training, Education, Academic–industrial partnerships, Food service

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-58

Survey on the Current Status of Education and Academic–Industrial Partnerships at Dietitian Training Universities in Vietnam First Report: Current Status of Education at Dietitian Training Universities in Vietnam

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Background and Objectives: In Vietnam, four-year nutrition courses were approved in 2012 and the health occupation "Dietitian" was born in 2017. In 2020, the Ministry of Health issued a notification regarding nutritional management at hospitals, and the legal system has been developed so that dieticians play an active role in society. We have investigated the current state of the educational environment and academic–industrial partnerships at dietitian training universities and examined how the Japanese food service industry can contribute to training dietitians in Vietnam. This first report focuses on the current state of the educational environment at dietitian training universities in Vietnam.

Methods: The survey was targeted to 20 universities that have, or are planning to offer, dietitian training courses in Vietnam. The content of the survey included the educational curriculum, educational status, and current situation of academic–industrial partnerships. In February 2022, a joint briefing session was held online with the National Institute of Nutrition in Vietnam and the questionnaire was sent out. The respondents were the department chairs of each university and full-time faculty members.

Results: Responses were received from 18 universities (90% response rate), including 12 of the 13 existing universities and 6 of the 7 that are scheduled to open. Regarding the fields on which education is focused, "clinical nutrition" and "public health" were reported by 18 universities, "school meals" by 16 universities, and "food service management" by 13 universities. Regarding the facilities and equipment, only 10 universities had test kitchens, and only 1 university had training rooms for school meals. Regarding out-of-school training destinations, "medical facilities" were reported by 17 universities, "public health centers" by 14 universities, while both "welfare facilities" and "companies" were reported by 7 universities. There was a tendency towards few opportunities to learn about food service management and mass food preparation in practice.

Conclusions: The findings of this survey suggest that dietitian training universities in Vietnam are currently focusing on the training of dietitians who are expected to play an active role in public health and medical settings.

Keyword: Dietitian training, Education, Academic–industrial partnerships, Food service

PAB(T5)-59

The consciousness of the salt intake of the women's students of the Japanese administrative dietitian training university

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Background and Objectives: The daily salt intake says that less that 5g are desirable in WHO. However, there are many daily salt intakes of Japanese. Therefore we examined the recognition of the intake salt of the student of the university (A student of the fourth grade) which trained an administrative dietitian. **Methods**: The subjects of we study was women's students at Hokkaido in Japan. The investigation method askes it for an answer, using the question vote that we made (20 questions). The surveys were conducted in April and May 2021 (immediately after entering and advancing to the next yare). The method of analysis was to divide the students into three groups of "adequate" "excessive" and "insufficient" in terms of their perception of their usual salt intake at different by the year and to compare the results among the groups. The χ^2 test was used for the analysis (p=0.05). **Results**: The total number of students analyzed was 140 (36 first year students, 38 second year students, 34 third year students and 32 fourth year students). Regarding their perception of their usual salt intake, in the first year students answered 61.1%"adequate", 38.9% "excessive" and no one "deficiency". In the second yare students answered 26.3% "adequate", 73.3% "excessive" and no one "deficiency". In the third yare students answered 17.6% "adequate", 79.4% "excessive" and 2.9% "deficiency". In the fourth year students answered 28.1% "adequate", 68.1% "excessive" and 3.1% "deficiency". More than half of the first-year students answered adequate". More than half of the students in the second year and above students answered "excessive". Significant differences (p=0.003) were found, indicating that there were differences in salt intake awareness by different by the year of student. **Conclusions**: In Japan, there are many seasoning, salt intakes from a processed food. We guessed, the first yare students the knowledge for the meal was poor. We hypothesized, but in the second year student and above answered "excessive" because they understood the criteria for salt intake and the difficulty of controlling salt intake.

Keyword: intake salt, woman university student, Japanese

PAB(T5)-60
The result of the survey of students on the off-campus dietician training practicums during COVID-19 pandemic period (Food Service Management)

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Background and objectives: To obtain a dietitian license, Students (Survey group of total 85 students; Male18, Female 67) went to an off-campus training from July 2021 to February 2022 during the COVID-19 pandemic period. There was food service facility (nursery centers, elementary and junior high school, facilities for elderly, company canteen) and hospitals for off-campus training. The purpose of this report is to obtain information from student's aspect and off campus facilities' supervisor aspect about student's anxiety before going to food service facility training including the feedback from student and evaluation form each facility's supervisor after training.

Methods: Before going to the off-campus training, student would conduct a web survey in July 2021. Then, after the off-campus training finished students would answer their feedback the self-assessment the handbook. The evaluation of off campus facilities' supervisor would be submitted on a paper basis. The data would collect and analyze for further use.

Results: Before the off-campus training start, the students had 5.0 ± 5.8 factors of anxiety (out of 13 factors). The 7 majors factor that students were worried about were "lack of knowledge and skills", " not to cause any inconvenience ", "What kind of training will be done", "communication ability", " challenges ", and " Is greetings and wording appropriate?". The self-evaluation after the off-campus training finished was 4.4 points ± 0.7 points (out of 5 points) for the students. The evaluation of the off-campus facility's supervisor was 4.0 ± 0.8 points. From result of the after-training survey, we could notice the significant differences between students and supervisor in aspect of placing the importance on evaluative factors. The list of evaluation factors below was higher from the supervisor's point of view than the students. It is that "Greeting / wording", "Communication, working manner and cooperative attitude", "Actively engaged in", "A sense of responsibility", "Training goal".

Conclusions: Improving knowledge and skills of students to reach the facility supervisor expectation, we will deepen the cooperation among teachers in charge of all subjects such as cooking to share the same goal. Also encouraging all faculty staff and students exchange greetings daily.

Keyword: Off-campus dietician training practicums , Food service management, Anxiety, Students' self-reviews, The evaluation of the off-campus facilities' supervisor

PAB(T5)-61
Tips of a skilled movement for peeling a whole apple with a kitchen knife

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Background and objectives: By clarifying the tips of kitchen knife manipulation, it will be possible to effectively teach to improve the kitchen knife skill. Therefore, we investigate the biomechanical features of the movement of peeling a whole apple with a kitchen knife.

Methods: We first assessed the movements of peeling a whole apple with a kitchen knife in 70 female university students. Then, we selected 3 skilled and 3 unskilled students for our main experiment. In the main experiment, we recorded kinematic data using a 3D motion capture (VICON) while the 6 students peeled a whole apple with a kitchen knife, and compared the biomechanical features of the movements of the participants.

Results: We found three differences in knife manipulation between the two groups: 1) Skilled students held the knife at about 45 degrees from the horizontal plane while unskilled students held it more horizontally. 2) Skilled students moved their right thumb in advance to lead the knife while unskilled students moved their right thumbs synchronously with the knife. 3) Skilled students held a space between their right thumb and knife while unskilled students put their right thumbs on the knife blade. In addition, skilled students and unskilled but relatively efficient students held the knife blade between their thumbs and index fingers while unskilled but relatively inefficient students held the knife with their index fingers extended on the dull edge.

Conclusions: We suggest that analysis of these biomechanical features is important for teaching the proper way to peel a whole apple with a kitchen knife.

Keyword: motor skill, kitchen knife, peeling apples

PAB(T5)-62
Assessment of upper arm muscle activity between instructor and student using surface electromyography

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Background and objectives : Specialists in nutrition are now expected to play a variety of roles in various fields. In university

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

nutrition education, there are four fields of study, such as "Clinical Nutrition," "Nutrition Education and Community Nutrition Care," "Sports Nutrition," and "Food Service," which are designed to provide basic knowledge of "human nutrition" as well as a variety of activities as a dietitian. However, there were not enough data about posture and setup while whole cooking. This study aims to assess muscle activity compare both instructor and student during various tasks in a kitchen. Methods : This study was demonstrated the different mass cooking of school lunch as a task simultaneously regular meals and allergy-friendly meals by both instructor and student. Surface EMG signals were recorded at a sampling frequency of 500 Hz using a sEMG system (Polymate A108, Japan), right and left both radial muscles and biceps brachii muscle. Results : Both participants completed the experimental procedures two different mass cooking of school lunch. There were significant differences while cooking time and integrated EMG by far the faster and the smaller in instructor.

Conclusions: This study has assessed the different of cooking skill between instructor and novice student. It was considered that to practice of cooking to get occupational skill.

Keyword: EMG, Cooking skill, professional experience

Conflict of Interest Disclosure: The authors declare no conflicts of interest associated with this manuscript.

Further Collaborators: None

PAB(T5)-63
Enhancing healthy-eating concept in Hospital staff, from environmental protection to food safety education.

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Background and objectives: Diet is related to environmental protection and food safety, in order to enhance the healthy food concept of hospital staff, our study is to help staff implement low-carbon diets, reducing the use of disposable tableware, and understand food safety through meal supply and education activities, so as to achieve environmentally friendly and healthy eating.

Methods: In the meal serving segment, 70% of the 16 dishes in the staff cafeteria are vegetable dishes, and all food are seasonal; In order to encourage staff to bring their own tableware, a deduction of 3 NT dollars is used as a reward method to reduce the use of disposable tableware. In the education section, an staff cooking competition was held on The theme of healthy cooking on World Chef's Day, and food safety knowledge videos and games were conducted on World Food Safety Day to promote the healthy food concept of employees.

Results: About 300 employees participate in low-carbon catering every day, and the number of people who get a 3NT discount with self-prepared tableware has increased from 1,000 people in year 2017 to 1400 people in year 2020 per monthly. As of year 2020, the use of disposable tableware has been reduced by 64,000, equivalent to 4.4 seats Taipei 101 altitude, which is the tallest building in Taiwan. During the educational activity, 400 employees watched the food safety video, 350 employees answered correctly, and the satisfaction of the activity reached 90%.

Conclusions: Diet is closely related to environmental protection and food safety. Dietitians can build a healthy food concept for hospital staff through meal design and educational activities.

Keyword: healthy-eating concept, low-carbon diets, education, food safety, disposable tableware

PAB(T5)-64
The Salt Remaining Rate of vegetables Due to Salt-rubbing

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Background and objectives: Salt reduction is important for preventing various diseases; thus, awareness of our salt intake is essential for our health.

Salt is used not only for seasoning food but also for food preparation, such as removing water from food by making use of the increase in osmotic pressure.

Not all of the salt used in the preparation process is ingested, but it is not clear how much salt remains in the food that has been prepared using salt.

In this study, salt-rubbing, a typical vegetable preparation treatment, was performed to determine the residual salt in foods after preparation.

Methods: The samples were daikon radishes, carrots, and cabbage, which are often served raw.

The shredded samples were salted by adding 1% salt, the vegetables were squeezed after 20 or 120 minutes of leaving, and the salinity of the squeezed juice was measured.

Results: The amount of water released from each sample after salting and squeezing was approximately 40%, 20%, and 15% of the pre-treatment sample weight for daikon, carrot, and cabbage, respectively.

The percentage of salt remaining in each sample was approximately 45%, 60%, and 60%, respectively, with no significant difference between 20 and 120 minutes of exposure.

Conclusions: The water content squeezed out was highest in daikon, followed by carrots and cabbage.

The amount of salt eluted was expected to increase with the amount of water released.

For the same vegetables, a correlation was observed between the amount of water released and the residual salt, where the quantity of water released was correlated negatively with the residual salt.

However, a comparison between vegetable types showed that cabbage had the lowest amount of dehydration, yet its

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

residual salt level was similar to that of carrots, indicating that the amount of residual salt also depends on the type of vegetable.

No significant difference was observed between 20 minutes and 120 minutes of leaving time, indicating that leaving time is not related to the residual salt amount.

Keyword: salt, salt-rubbing, vegetables

PAB(T5)-65
A mixed-methods study to explore salt preferences, procurement, and utilization practices among local households to inform a trial of multiply-fortified salt in Punjab, India

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Background and objectives: Context-specific information on salt preferences, procurement, and utilization is important to plan and implement salt fortification interventions effectively. The current study explored these practices among non-pregnant women of reproductive age (NPWRA) in Punjab, India, to inform the design of an upcoming trial of multiply-fortified salt (MFS) in this area.

Methods: Data were collected between December 2020 - February 2021 using semi-structured questionnaires administered to 100 NPWRA across 11 villages in the Mohali district and eight focus group discussions (FGD) (4 among NPWRA 18-40 y; 4 among women >50 y). FGDs were conducted in Punjabi and transcribed verbatim. Descriptive statistics were used to summarize the quantitative data, and FGD transcripts were coded with Dedoose software and analysed using thematic analysis.

Results: Ninety-six (96%) of the women used Tata iodized salt and rest 4% used patanjali iodized salt and crystal iodized salt for food preparation and seasoning. NPWRA described Tata iodized salt as having good quality and taste, reasonable price, white color, and free-flowing texture. Black and pink salt were also used in smaller quantities to enhance the flavor of fruits and salads immediately before consumption. Nearly half of the women reported seasoning food at the table, and among these women 74% used a different type of salt than used for coking, primarily black salt (77%). Ninety-eight (98%) women procured salt monthly from local markets and corner shops in their village or adjacent villages. Most women (62%) procured 1kg of salt every month and stored it (87%) in plastic containers. Less than one-quarter of NPWRA reported sharing salt, and FGDs revealed that women believed sharing salt with family was acceptable but not with neighbours as this brought bad luck.

Conclusion: The current study has confirmed that refined, iodized salt is widely used and will be an appropriate vehicle to evaluate in the upcoming MFS trial. Educational messaging throughout the trial will emphasize the need to use the MFS salt for all discretionary purposes including flavouring fruits and salads and discourage salt sharing with family members who live outside the index Household.

Keyword: Multiply-fortified salt, salt preferences, salt procurement, salt utilization, focus group discussions

Conflict of Interest Disclosure: Authors declare no conflict of interest

Further Collaborators: None

PAB(T5)-66
Changes in the Vitamin C Content of Vegetables Due to Salt-rubbing

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Background and objectives: A discrepancy between the calculated nutritional value using the standard tables of food composition and the actual measured nutritional value of cooked meal has been noted. This is because the loss or increase of nutrients during the cooking process is not considered. Although there have been reports of nutrient comparisons before and after cooking, changes in water-soluble nutrients are expected to occur even during non-heat cooking, such as cutting, soaking, and pressing. In this study, we focused on vitamin C among water-soluble vitamins and revealed the changes in the vitamin C content of vegetables before and after salt-rubbing, which is a type of non-heat cooking.

Methods: The samples were daikon radish, carrot, and cabbage, which are often served raw. The shredded samples were rubbed with 1% salt, and left to stand for 20 min, after which the water that released from the vegetables was squeezed out. The vitamin C content in the samples before and after salt-rubbing as well as in the squeezed water was determined using the hydrazine-HPLC (High Performance Liquid Chromatography) method.

Results: The weight of each sample after salt-rubbing and squeezing treatment was approximately 60%, 70%, and 80% of the pretreatment sample weight for daikon radish, carrot, and cabbage, respectively. The residual rate of vitamin C in each sample after treatment was approximately 75% for daikon radish and 90% for carrot and cabbage.

Conclusions: Water release by salt-rubbing and squeezing was the highest in daikon radish, followed by carrots and cabbage. Vitamin C, a water-soluble vitamin, was predicted to be lost following water release. However, the residual rate of vitamin C was the lowest in daikon radish, but was comparable in carrot and cabbage. The results suggested that the loss of vitamin C in vegetables due to salt-rubbing depends on the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

amount of released water as well as differences in cellular tissue structure and interaction with the contained nutrients.

Keyword: salt-rubbing, vitamin C, vegetables

PAB(T5)-67
Effect of dietary education on Japanese workers for 3 weeks using table top memo

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Background and objectives: In Japan dietitians manage the nutrition and health of workers at lunch using dietary guidance media. The purpose of this study was to clarify the effectiveness of dietary education using table top memos for three weeks.

Methods: This study was a cross sectional study. We conducted 150 employees who usually ate the lunch in the employee canteen of one company in July 2017. First of all we conducted a survey of the habitual food intake of the subject over the past month using a brief type self administered diet history questionnaire and discovered that many subjects had an excessive salt intake. We created four types of table top memos for salt reduction education and placed them on the table in the employee canteen for seventeen consecutive weekdays based on the results. We taught that reducing salt like not drink udon and ramen soup in the tabletop memos. The questionnaire was conducted using a self administered questionnaire after three weeks dietary education using table top memos. The number of subjects analyzed was 137 excluding invalid answers. There were two categories depending on whether the answer to the question was yes or no.

Results: The ratio of subjects who Table top memos affected their eating habits was 62.5% and 28.1% respectively among 112 subjects who can incorporate by table top memo and 25 who cannot incorporate. There was a significant difference between these categories.

Conclusions: Three weeks of dietary education using table top memo could be an opportunity to improve the diet of workers. There are two points to improve the educational effect. One is to ensure that workers read the tabletop memos and the other is to make the content interesting and be able to incorporate the educational content into your daily life the workers.

Keyword: Table top memo, Japanese worker, Dietary education

PAB(T5)-68
Nutritional evaluation for High protein CHANKO and Traditional CHANKO

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Background and objectives: The sumo is traditional and popular culture in Japan. It was the classic sport that occurred from human competition in strength and scuffle. Due to the hitting the whole body and contact to wrestle with competition partner, the body weight has bigger is an advantage. It was served during sumo tournaments is made exclusively with chicken, the idea being that a wrestler should always be on two legs like a chicken, not all fours. However, there was not enough data to investigate nutrition evaluation of Chanko. Therefore, the purpose of this study nutritional evaluation of CHANKO which contains a lot of protein that was the source of muscle, and NORMAL CHANKO which was previously cooked by athletes.

Methods:It was selected Kyushu Institute of Information Science as a famous college sports club in Sumo. CHANKO by college club sports cooking were polytheism divisions, washing vegetables, cutting vegetables, seasoning of the chicken meat dumpling, work out mince as dumpling, and to put food into a big-hot caldron. High-protein CHANKO contains soy milk, Koya tofu, sesame seeds, and pork. It was performed nutritional evaluation by commercial software by Kenpakusha, Japan.

Results:There were 26 items as food into the caldron, minced chicken meat, rice wine, egg, soy sauce, Chinese cabbage, frying tofu, sprout, hypsizigus mamoreus, enoki mushroom and seasoning. It was cooking the standard quantity as a stew before 100 for 20 Sumo players. High-protein CHANKO of PFC is 19:24:57, Traditional CHANKO of PFC is 16:31:53.

Conclusions:CHANKO was a healthy diet because of rich volume of vegetables, low carbohydrate. Due to the calorie intake, there were a lot of using sesame oil for mice addition as a connection and improved flavor. High protein CHANKO was suitable for athletes. It was considered that in case of weight-limited competition, CHANKO has possibility low calorie diet food both a small amount of oil and chicken breast. The reason for gaining weight was eaten a lot of white rice. It was showed well-balanced meals for sports nutrition to adequate personal conditions.

Keyword: Cooking skill, High protein, Professional experience, Sumo

Conflict of Interest Disclosure: Nothing

Further Collaborators: Nothing

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-69

Traditional food intake affecting dietary diversity of a deep rural community in KwaZulu-Natal, South Africa

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Background and Objectives: The Zulu people are the largest ethnic group (77.8%) in South Africa with an estimated 10 – 12 million people living predominantly in the province of KwaZulu-Natal. Traditional heritage foods that are consumed by Zulus, but also other ethnic groups, includes: ujeqe (steamed bread), samp and beans, phutu porridge (classified within the starch food group), amasi (fermented cow's milk), amadumbe (root crop similar to sweet potato) and imifino (wild edible greens including morogo or spinach leaves).

This study aimed to determine by self-reported food intake questionnaires the dietary intake patterns and diversity among adults residing in a deep rural community in KwaZulu-Natal, South Africa.

Methods: Participants were conveniently sampled with door-to-door visits within the Umzinyathi District – one of the most underdeveloped rural areas of KwaZulu-Natal (KZN), South Africa, consisting predominantly of Zulu people. Trained fieldworkers administered 24 hour recall to determine dietary diversity and dietary patterns (per consumption of 12 food groups), as well as anthropometric measurements.

Results: The black African study sample (N = 150) were predominantly female (83.3%). Primary food group consumption indicated dietary pattern intake of mainly cereals (97.3%), sweets (94.6%), miscellaneous items (93.3%) and oils and fats (81.3%) predominantly. Although 70% of participants reported daily vegetable consumption, the dietary pattern was limited to tomatoes and onions. This was followed by an intake of flesh and organ meats (40%) and fruit (36.6%). Dietary patterns indicated that nearly 56.6% consumed 4 – 6 different food groups, while 14.6% consumed 10 – 12 food groups. In this rural area traditional food consumption included jeqe (steamed bread), samp (dried corn kernels that have been stamped and chopped), organ meats and indigenous vegetables like amadumbe tubers and amaranth (wild spinach).

Conclusion: According to the self reported food intake questionnaire the dietary pattern intake of this rural community indicates a lack of dietary diversity from limited food intake and availability within the area.

It is suggested that regular food education to be done at nearby clinics to educate patients on changes to their dietary pattern to include more diverse, healthy food groups and starting a vegetable garden.

Keyword: Food Culture, Traditional Food, Zulu ethnic group, Rural community, Dietary diversity

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T5)-70

The characteristic of Bhutan's dairy products in use cow and yak milk and rice in the meal

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Background and objectives Such food in the European region is said to be “wheat and meat ”. Mean while, Food in the Asian region is said “rice and fish” as its centerpiece. As for Bhutan, Located in the buffer zone in the East and Weat Eurasian. Rice and milk is the center of food. Bhutan's dairy products have been made from cow and yak milk. keep a cow in the low place, Yak is kept in the highlands above 3,000 m sea level. **Methods** In 2015 and 2018, Investigated and characteristic of the traditional cheese to make in Bhutan, and rice in the meal. Chemical composition and general mineral analysis of the cheese. **Results** A non-ripe type cow's milk made three kind of cheese called “datui”, “tyugo”, “thippa”. Datui and red pepper is large amount of rice are eaten every day . The amount of meat to eat is small, Cheese is important protein source. And yak in the area of high altitudes. The whole yak milk is fermented at first, then the milk fat called “gee” is removed, and finally the skimed milk with a reduced amount of lactose is processed. “Gee” is important energy taken, and add in tea. Consequently, such dairy products possible to be used even by lactose intolerance people and this technique is allow effective use of the milk. Bhutan's milk processing technique is said to have Tibetan origin. Dairy products of Bhutan and geographically distant Mongolia are different, but they have the same properties and similar amounts of energy. Yak skimed milk fermented cheese named “syorusei”, in casein squeeze up young aged in yak leather bag and after smoke dried from 3 month. The “syorusei” is not add salt but not corrupt .The four types of cheeses highest calorie content measured 403 kcal / 100 g is “syorusei”.In Bhutan, the homemade cheese and rice play important role in nutrition. **Conclusions** The increase in salt intake while enabling the eating of rice in large quantities. Bhutan's food centerpiece of “rice and milk”.

Keyword: Bhutan's dairy products, milk and rice, Yak

PAB(T5)-71
Acceptance of insects as food and its influencing factors in Malaysia

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Background and objectives: Entomophagy (eating insects) is a traditional practice in many countries since prehistoric times. The concept of utilising insects as human food has gained massive attention recently due to their high nutritional values with low environmental impacts. However, the acceptance of eating insects as food in Malaysia is still unclear. Therefore, this study aimed to determine the acceptance of insects as food and its influencing factors among adults in Malaysia.

Methods: A cross-sectional online survey was conducted among 292 Malaysians aged 18 years and above from Klang Valley and Kuching. Information on insect-eating experience, general attitudes towards eating insects as food, and possible reasons for rejecting insects as food, were self-reported by the respondents. The Chi-square test of independence was used to compare the two locations. The Friedman test followed by a Wilcoxon signed-rank posthoc test was used to determine the main factors influencing the acceptance of insects as food.

Results: A total of 104 respondents (35.6%) reported that they had consumed insects previously, with sago worm, cricket and grasshopper being the top three highly consumed insects. Although one-third (30.1%) of the respondents reported that they accepted insects as food, only 18.2% of the respondents were willing to eat insects as food in their daily life. However, there was no significant difference between adults from Kuching and Klang Valley in terms of the acceptance and readiness towards insects as food. Insect texture, food safety issues and feelings of disgust were the main identified factors influencing the non-acceptance of insects as food.

Conclusions: The acceptance of insects as food among Malaysians are generally still low, with the main barriers being sensory attributes, food safety and aversion towards insects as food. Future studies should include interventions that consider these factors to better encourage more Malaysians to accept insects as food.

Keyword: Entomophagy, Edible Insects, Acceptance, Malaysia

Conflict of Interest Disclosure: No conflict of interest.

PAB(T5)-72
Analysis of trends in food and nutrition intake and eating habits of younger generation in modern Japan using quantification of the tendency toward the basic ”Washoku" pattern and "Japanese Dietary Pattern"

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Background and objectives: With the modernization of food, dietary trends have changed drastically. Dietary trends in modern Japan have been analyzed through the National Health and Nutrition Survey by Ministry of Health, Labour and Welfare. Since this is a survey on all generations and requires time and effort to cooperate with the survey, it is possible that particularly young single-person households with mostly high school attendance or gainful employment rates were not included in the survey. Based on these facts, the following analysis was conducted to elucidate the overall dietary habits of the younger generation.

Methods: In this study, we made two types of analysis on the dietary contents of university students. As a duplicated diet method, we asked university students (n=26) to send us photographs of their meals for one week, based on which we cooked replicated meals. According to the replication, we analyzed the amount of food and nutrients consumed by the younger generation. In addition, as a 24-hour dietary recall method, we asked university students (n=1,324) recording the contents of their one-day meals. The students also responded to a questionnaire regarding their living environment and lifestyle.

Results: We have developed our own quantification to the tendency toward the basic *Washoku* pattern and “Japanese dietary pattern” regarding each of the dietary contents of university students. Both the duplicated diet method and the 24-hour dietary recall method showed that even they tended to have a more nutritionally balanced diet when they take the above two patterns of dietary contents. We were able to identify trends toward over- and under-intake of some nutrients in the diets of younger generation in contemporary Japan.

Conclusions: Although the dietary habits of the younger generation have been reported insufficient vegetable intake and calcium intake, and excessive fat intake in the analysis of the NHNS, furthermore, the actual dietary problems among the younger generation would be more serious. It is also suggested that although the younger generation has received food and nutrition education during school education, they are not yet able to put their knowledge of food and nutrients into actual practice in their diets.

Keyword: Food intake, Nutrition intake, Japanese dietary pattern, the basic Washoku pattern

Conflict of Interest Disclosure: This work was supported by JSPS KAKENHI Grant Number JP19K02314.

Further Collaborators: Maiko Murakami
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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Chiko Yamamoto

PAB(T5)-73
Behavioral study of bakery users in special need

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Health and food sectors in Mongolia are in the development stage comparatively with the world, diabetes is increasing dramatically as estimated by the survey ofInternational Diabetic Association. For instance the registered diabetic patients are increased from 97300 in 2017 to 129000 in 2022. Exercises and proper nutrition are crucial for diabetic patients as well, then these people needs to take attention in food. In Mongolia, there is a lack of bakery cook for people in special need, people do not know where they buy what kind of cakes and no information and knowledge in this regard. So information and knowledge is needed for those people who are in special needs.

In my research 30.7 percent of the participants are having with diabetes for 1-3 years after the diagnosis and 27.7 percent are having for 3-5 years respectfully.

It shows that for the last few years, diabetic illnesses are increased. Totally 279 survey participants out of 368 or 75.8 percent answered that they are in trouble when use products with sugar. But 176 participants out of 368 or 47.8 percent do not

substitude sugar when they are in trouble using sugar. In total 37.2 percent of participants seek sugar free cakes and cookies, 25.5 percent seek sometimes and 37.2 percent do not seek it. This shows that sugar free cakes and cookies are not readily available. It is evident by the answer that such products are seldom found by 54.9 percent of participants and not available by 45.1 percent of participants. Then no participant answered that it is available.Half of the participants or 52.2 percent do not have an advice in use of cakes and cookies from specialists and nutritionists and take carelessly for thier health. The survey target popluation is people in special need and the survey findings would be used to improve thier quality of life and maintain treatment results.

Keyword: mongolia , diabetes, bakery, sugar free

PAB(T5)-74
Effects of different drinks in divided diet on sensor glucose values after evening meal

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Purpose: This study performed flash glucose monitoring (FGM) of the interstitial fluid after drinks were drunk as a divided meal to observe the sensor glucose value (SG value) and its area under the curve (AUC). It then compared the results of investigating effective methods of eating to suppress postprandial blood glucose elevation.

Methods: The subjects were 12 healthy women in their twenties and the study was performed according to the blood glucose level measurement protocol of the Japanese Association for the Study of Glycemic Index. The test meals were 350ml of Fanta (Coca-Cola Co., Ltd.) for group A for which sugar in the principal component, 200ml of milk (Megmilk Snow Brand Co., Ltd.) for group B for which protein- and lipids are the principal components, and 330ml of green smoothie (Kagome Co., Ltd.) for group C for which dietary fiber is the principal component. A crossover study was conducted in which subjects consumed a divided meal at 06:00 pm after three hours of fasting and a dinner at 09:00 pm. The measurements were taken with the subjects wearing the Free Style Libre (Abbott Japan LLC) with the values read and recorded. The AUC was then obtained using those measured values.

Results: Preprandial and maximim SG values were 78.8 mg/dl and 113.8 mg/dl respectively in the control group (no divided meal). The corresponding values for A, B and C were 77.6 and 110.5, 85.8 and 119.0, and 89.8 and 118.1 respectively. The maximum rate of change based on the time of dinner intake was 44.4% (45 min from the start of the meal) in the control group, followed by 42.5 (90) in A, 38.6 (60) in B, and 31.6 (90) in C. The AUC of the rate of change in SG values was lowest in C followed by the B, with A showing the highest value.

Discussion: Group A, which included the highest sugar content, had a high rate of change of SG values after the evening meal, which may have been influenced by the rapid rises and falls in SG values during divided food intake.

Keyword: Divided meal, Flash glucose monitoring

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-75
Questionnaire survey results on fish, calcium and protein intake

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Background and objectives: Since the calcium intake has not reached the target amount in the Japanese diet. It is also recommended to maintain protein intake from the viewpoint of preventing sarcopenia and frail in the elderly. Therefore, as a first step to understand the actual situation, this study conducted a questionnaire survey on the intake of fish rich in EPA and DHA and the intake of Ca and protein. **Method**: A questionnaire survey was conducted on 61 participants regarding the intake of fish, Ca and protein. The questionnaire method is self-administered, and I asked the 15 items. **Results**: The mean ± standard deviation of 61 participants (18 to 28 years old) was 21.1 ± 2.0 years of age, height of 158.4 ± 5.9 cm, and weight of 52.9 ± 7.1 kg. According to the results of the questionnaire survey, the average desired price for purchasing fish was 266 ± 162 Japanese yen (2.2±1.35 USD), the frequency of eating fish was most often 1 to 2 times a week at 41.0%, and the frequency of eating meat was most often 3 to 4 times a week at 67.2%. Eggs were most often eaten 3 to 4 times a week at 47.5%, and soy products were most often eaten 1 to 2 times a week at 34.4%. 83.6% answered yes to whether they like fish, 75.4% answered yes to know fish that can eat bones. And 82.0% answered yes to want to eat fish that can eat bones. 68.9% answered yes to whether they felt lack of calcium, and 95.1% answered yes to whether they wanted to take calcium positively. 32.8% of the respondents answered yes to whether they felt protein deficiency, 90.2% answered yes to whether they wanted to take protein positively. **Discussion**: Participants this time ate meat and eggs more often than fish and bean products in their daily lives. We believe that it is necessary to increase the consumption of fish in order to extend healthy life expectancy, so we would like to continue to recommend the consumption of fish.

Keyword: Calcium intake, Protein intake, Fish intake, Questionnaire survey

PAB(T5)-76
Association between Food Intake Frequency and Food Procurement Methods at the Household Level, in Xaybouathong, Khammouane, Lao PDR

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Objective: Lao PDR has the high prevalence of stunting among children under five years of age among ASEAN countries, and ISAPH found in a previous study that one of the direct causes of this is the strongly biased dietary diversity of children. However, there is insufficient information on the background of the lack of diversity. Therefore, to analyze the bias in food intake from the perspective of access to food at the household level, we investigated the association between the way food is procured methods and food intake frequency.

Methods: In July 2017, all households with children under five years old were interviewed about the frequency of food intake and their procurement methods in three villages in Xaybouathong District, Khammouane Province, Central Laos. A total of 25 foods were selected through the discussions with health service professionals at the Xaybouthong hospital. This list was also constructed in terms of dietary diversity. Then, the respondents were asked about intake frequency. As for the procurement types, the respondents were instructed to select one option from four: 1. monetary purchase, 2. own production (cultivation/farming), 3. hunting/gathering, and 4. other.

Results: Valid responses were obtained from 209 of the 226 eligible households. Ninety percent of the households hunted and gathered bamboo shoots, frogs, small fish, crabs, and grasshoppers, while instant noodles, milk, soy milk, soybeans, and eggs were purchased with money. Onions, chickens, and ducks were procured through production by more than 70% of households. Procurement methods for the other 12 foods were diverse among the respondents. The top five foods that were eaten more than three times a week were bamboo shoots, onions, crab, eggs, and instant noodles, while the foods that were rarely eaten were soybeans, milk, duck, beef, and mango.

Conclusion: Although some foods have limited procurement methods, it is clear that people procure foods from a combination of these sources in the target areas. Some foods (e.g., soybeans and duck) were available through production or hunting and gathering but were consumed less, while some foods (e.g., instant noodles and eggs) were consumed frequently even if they had to be purchased with money. The residents may be SELECTING the foods they want to eat based on preferences, customs, or some other factors. Therefore, we must pay attention to not only food access but also other factors that influence the household's food choices that might cause low dietary diversity in children.

Keyword: Food Choice, Food Intake Frequency, Food Procurement Methods, Lao PDR, Rural Area

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-77
Current Dietary Practices in Rural Zambia A Day in the Dry Season in Kachenjera and Mwenbeshi, Lusaka Province

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Background and objectives: In Zambia, the undernourished population was 47.4% of the total population in 2014 and remains high. In rural areas, more than 65% of the working population is in agriculture and tends to be chronically undernourished. The aim of this study was to understand the actual dietary situation in rural areas of Chilanga in Lusaka Province, and to link this to support for healthy eating and improved nutrition among small farmers from the perspective of sustainability.

Methods: The study population consisted of 50 farmers living in two villages in Lusaka Province: Kachenjera and Mwembeshi. The study period was September 9-18, 2018, and involved physical measurements, daily dietary surveys using a combination of food records and photography, and interviews to investigate their living conditions.

Results: Mean BMI was 22.6 for 12 male participants and 26.7 for 38 female participants; the percentage of underweight individuals with a BMI under 18.5 was 2% and the percentage of obese individuals with a BMI over 25 was 48%. The staple food was nshima, which is made from corn flour, which was eaten for 5.7% of breakfasts, 89.4% of lunches, and 97.9% of dinners. The percentage of those missing meals was 25.5%. The percentage of respondents who ate no main dish at all in a day was 19.1%, and the percentage of respondents who ate no side dish was 25.5%. Munkoyo, a homemade fermented corn beverage, was consumed by 27.7% of respondents, for breakfast and by 36% for snacks. Because of its poor palatability, cold nshima tended to be undesirable and was discarded or fed to livestock.

Conclusions: The diet of the people in this region was biased toward the staple food and lacking in protein, vitamins, and minerals. We believe that reverting from corn-derived nshima to minor grains, which have been eaten for centuries, will improve the nutritional balance. Because many meals did not have all of a staple, main dish, and side dishes, and food is in short supply during the off-season in this region, nutrition education, food storage, and the use of leftover food should be studied in the field.

Keyword: Zambia, Healthy eating, Nutrition education, Food storage, Dietary bias

PAB(T5)-78
A Literature Review of the Nutrition Status and Dietary Practices of Ethnic Minority Groups (Indigenous People) in the Past Ten Years in China

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Background and Objectives: Indigenous food systems can affect multiple aspects of Indigenous people's health. In China, the government has declared that there are no Indigenous peoples in China and instead uses the term ethnic minority groups. No existing studies have broadly investigated or summarized the nutritional status and dietary practices of all 55 ethnic minority groups living in China. These 55 groups represent 8.89% of the total population in China.

Methods: To understand this critical issue, a systematic review was conducted. The selection criteria were that research publications should be about nutritional status or dietary practices among ethnic minority groups in China, specify the name of the ethnic minority group, and be published within the past ten years. For this literature review, 111 publications were selected. Linear regressions were applied to explore what factors can affect the total number of publications for an ethnic minority group.

Results: The literature review revealed five crucial findings. First, dietary intake data that represents the general people of an ethnic group is only available for 15 ethnic minority groups; there is data for only seven ethnic minority groups on both nutritional status (anthropometric and nutrients intake/deficiency) and dietary practices (dietary intake and dietary habits). Second, ethnic minority groups in China are suffering from double-burden malnutrition and consuming unhealthy diets. Their undernutrition rate has been decreasing while the overnutrition rate has been increasing in the past years. Third, among all selected publications, the most prevalent study populations are primary and middle school students. Fourth, ten ethnic minority groups with a total population of 845,420 are lacking data on both nutritional status and dietary practices. Fifth, generally, there were more publications about an ethnic minority group with a larger population or the group only inhabit in a specific region.

Conclusions: More national-level programs and timely surveillance is needed to monitor the nutritional status and dietary practices of ethnic minority groups in China. More studies involving maternal nutrition, targeting underrepresented ethnic minority groups and age groups, and exploring traditional food systems in China are also essential to better understand and address this issue.

Keyword: Indigenous Nutrition, Chinese Ethnic Minority Group, Dietary Practices, Nutritional Status, Traditional Food Systems

Conflict of Interest Disclosure: There is no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-79
Where do Inhabitants of the parish Kanyanya in Kampala, Uganda shop?

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Background and Objectives: As Africa is urbanizing, the urban population in Uganda increased from 7.4 million in 2014 to 9.4 million in 2017. Thus, the dietary aspiration of the African population is changing, and urban food systems have to evolve rapidly to address the new demand. This requires a deep understanding of the current food system. Where do people shop for their basic food items and does this change over time when they are informed about healthier food choices? We contribute to the literature by identifying the different used food retail sources of inhabitants of a low-income area in Africa and how these change over time.

Methods: Kanyana parish (Kawempe division, Kampala, Uganda) was selected, which has similar demographic characteristics to Kampala city. Respondents were interviewed twice, first in March-April (mid-COVID 19 look down) and in December 2021 (post COVID-19 look down). A seven-day households food consumption recall was administered, capturing food sources for each named food item. Additionally, three Focus Group Discussions (FGDs) with parish representatives (disaggregated into women, men and youth) were conducted to gather information around the used food sources in 2020 (pre-COVID-19).

Results: In total, 376 households were interviewed twice, while 85 inhabitants participated in the FGDs. Preliminary results indicate that six different food retail stores are used (markets, food vendors, kiosks, butchers, supermarkets, retail shops). In early 2021, 50% of households reported to source food from retail shops and 29% from the market. The market was used by slightly more households in December. While in 2020, food stalls (fixed stalls in residential areas) were reported to be the main food outlet used by the community to purchase their food items.

Conclusion: Traditional retail outlets are still the major food supplier in a low-income parish, although the magnitude and drivers like the availability of healthy food products are not yet clear. The next steps are to identify which food items are sourced at the different retail outlets and at the different time points, as well as to analyse usage patterns of the three groups of intervention (control group, flyer, flyer and text messages).

Keyword: Urban food system, Kampala, Food sources, Traditional and modern retail

Conflict of Interest Disclosure: No conflict of interest.

PAB(T5)-80
The impact of sensitization and capacity building on the utilization of indigenous foods in household nutrition in the upper east region, Ghana.

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Background and objective: Malnutrition is one of the debilitating health conditions that affect the fast-growing population in Africa. Global trends have revealed a persistent increase in malnutrition, with 121 countries being plagued by either one type or class of malnutrition. Statistics reveal that approximately 32% of global disease burdens have a direct relationship with malnutrition. In Ghana, numerous interventions have been implemented to improve the malnutrition situation. Though there have been observed improvements, malnutrition persists. Food insecurity, improper dieting, culture, and ignorance of the importance of indigenous food resources to sustainable nutrition among others primarily account for persistent malnutrition, especially in northern Ghana. Studies reveal that indigenous foods have the potential to contribute to addressing malnutrition in Africa. However, poor perceptions about indigenous foods limit their utilization. The absence of sensitization and capacity-building on the utilization of nutritious indigenous foods may increase the risk of malnutrition amongst household members. **Methods**: This study was conducted in three communities in the Upper East Region of Ghana, where under-nutrition is on the ascendancy. We explored the impact of sensitization and capacity-building of women on the usefulness of indigenous foods to combating malnutrition. The study was executed in two phases. The first phase involved sensitization and capacity-building events. The second phase involved an analysis of the narratives of twenty participants, using Interpretative Phenomenological Analysis to assess the impact. **Results**: The narratives from participants revealed an improvement in the health of their household members and were attributed to the insight and knowledge they gained during the sensitization and capacity-building events. Participants indicated that they now consume more indigenous foods than before. Participants' narratives revealed other benefits such as economic gains, positive psychological impact, and behavioral change. **Conclusion**: The sensitization and training programme organized was impactful, and the gains are sustainable. The breadth of the impact indicated that the programme touched on various dimensions of the wellbeing of participants, which is an indication that sensitization and capacity-building is one of the ways to encourage indigenous foods consumption, which is a sustainable way of combating malnutrition. Efforts should be made to maintain and improve these gains.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Sensitization, Capacity-building, Indigenous foods, Utilization,, Malnutrition

PAB(T5)-81
Food security awareness and attitude of food-supervisors in Albania

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Background Food is handled by numerous persons, thus rising the possibilities of food pollution because of inappropriate management. Intentional or accidental pollution of food through large scale fabrication might jeopardize the health of customers, and have very costly outcomes on a country. The aim of this study was to evaluate the food safety knowledge and attitudes among food- supervisors in Albania.

Methods The study was performed by means of a cross-sectional survey of 25 institutes using a questionnaire to 326 food-supervisors. The survey was arranged into five distinguishing parts to gather information on demographic features, workers' job contentment, knowledge on food security and food hygiene practices.

Results: The most of the food-supervisors were among 45-55 years (32 %). Female participants were (65%). In our survey, the food-supervisors were well-informed about sanitary practices, housework and sanitation processes. Nearly all of the food-supervisors were conscious of the overall sanitary practices in the work environment, such as hand wash (95 %), using gloves (70%), good cleaning of the devices (83%) and detergent usage (67%). About illness conduction, 76.2% of the food- supervisors did not recognize that Salmonella is a food borne pathogens and 66 % did not identify that hepatitis A is a food allowed pathogen. Logistic regression analysis indicated statistical significance ($p < 0.05$), for models in which the variable was the level of education.

Conclusions: Generally, the food-supervisors have satisfactory understanding in food security but this does not decode into stern sanitized practices through dealing out and controlling food products.

Keyword: Food security, Albania, Food-supervisors

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T5)-82
profiling of commercially produced complementary foods in three Southeast Asian and four West African contexts

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Background and objectives: Commercially produced complementary foods (CPCFs) for infants and young children vary widely in quality, with some containing high levels of added salt or sugar. In 2019, the WHO Regional Office for Europe published a nutrient profiling model for CPCFs (WHO Europe CPCF NPM) for Member States to use to restrict inappropriate promotion of CPCF products in their countries. The WHO Europe CPCF NPM is one of the first NPMs developed specifically for CPCF products and its application to markets in other regions is a first step in enabling the validation and use of nutrient profiling for CPCFs globally. This study piloted the WHO Europe CPCF NPM in three South-East Asian and four West African contexts to assess the nutritional suitability of CPCFs in regions where markets for these products are rapidly expanding.

Methods: CPCF products were purchased in Cambodia (n=68), the Philippines (n=211), and Indonesia (n=211). Secondary datasets of CPCF label information were purchased for Burkina Faso (n=20), Cameroon (n=52), Ghana (n=127) and Nigeria (n=109). Using product label information, nutrient composition and content of CPCF were assessed against the WHO Europe CPCF NPM.

Results: The majority of CPCFs sold in both Southeast Asia and West Africa performed poorly in the WHO Europe CPCF NPM. Only 1.9% of products in Cameroon, 4.4% in Cambodia, 10.0% in Indonesia, 10.0% in Burkina Faso, 15.8% in Ghana, 20.2% in Nigeria, and 37.0% in the Philippines complied with WHO Europe NPM nutrient composition requirements. The presence of added sugar and sweeteners were particularly problematic. Fifteen percent of CPCF in Burkina Faso, 16.2% in Cambodia, 21.1% in Nigeria, 27.0% in Indonesia, 30.8% in Cameroon, 37.0% in Ghana, and 58.8% in the Philippines contained total sugar content levels that would require a 'high sugar' warning.

Conclusions: Most of the analyzed CPCF were not nutritionally suitable to be promoted for older infants and young children based on their nutrient profiles, with many containing high levels of sugar. It is crucial to introduce new policies, regulations, and product standards to limit the promotion of inappropriate CPCF in the South-East Asia and West Africa regions.

Keyword: nutrient profiling, complementary feeding, infants and young children, West Africa, Southeast Asia

PAB(T5)-83
Problems with labelling Foods with Function Claims

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Background Foods for Specified Health Uses (FOSHU) and Foods with Function Claims (FFC) are Foods with Health Claims that can be labeled with health functions. FOSHU began in 1991 and allows for the labeling of health functions that have been approved by the national government through individual review ("approved labeling"). The FFC was begun in 2015 as a simplified version of FOSHU, which allows food business operators to label health functions on their own responsibility. The health functions to be displayed are "Notified Labeling" and have not been approved by public authorities. Since FFC is easier to label than FOSHU, the number of FFC notifications has increased dramatically, while the number of applications for FOSHU has sharply declined. In addition, there are many health functions in the FFC labeling that are not permitted by FOSHU. I have investigated the problems with FFCs, which have been present since the inception in 2015, and have compared them with FOSHU based on public information on the website of the Consumer Affairs Agency.

Methods For FOSHU, I referred to the "List of permitted items of food for specified health use" (updated on December 22, 2021), and for FFC, we referred to the "Notification search site for food with functional claims" (updated on February 22, 2022).

ResultsThe number of permitted FOSHUs was 1,832 over 30 years, and the number of FFCs with notification acceptance was 5,080 over 7 years. The number of permitted FOSHU was 104, 93, 30, 39, 23, 8, and 16, and the number of FFC notifications received was 310, 620, 452, 690, 882, 1,067, and 1,059 from FY 2015 to FY 2021 (FY 2021 was mid-year). The health functions that can be labeled by the FFC are basically the expressions approved by FOSHU. However, there are some labels that do not fall under this category, such as "reduction of fatigue," "improvement of cognitive function and memory," and "reduction of stress“, as well as products that refer to "uric acid levels" and "liver function".

Conclusion FFC labeling may be misleading to consumers.

Keyword: Foods with Health Claims, Foods for Specified Health Uses, Food with Function Claims, food labeling

PAB(T5)-84
Front-of-pack warnings for commercial complementary foods available online in Chile, Brazil, Mexico, United Arab Emirates and the United Kingdom

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Background and objectives: Commercially produced complementary foods (CPCFs) can provide energy and nutrients for infants and young children during a critical period of development. However, some CPCFs contain inappropriate levels of concerning nutrients, such as sugar and sodium. Front-of-pack nutrition labelling (FOPNL) provides a mechanism for communicating the nutritional quality of food and beverage products to consumers. It is critical that the nutritional quality of these products be communicated clearly to caregivers to ensure informed decision-making for child feeding and to protect young children's diets. This study evaluated CPCFs against national FOPNL regulations.

Methods: Secondary datasets of CPCF label information for products sold online were purchased from Euromonitor International, including instant cereals, purees, and snacks/finger foods. Datasets included 41 products from Brazil, 73 from Chile, 170 from Mexico, 135 from the United Arab Emirates (UAE), and 643 from the United Kingdom (UK). Nutrient content information was evaluated against FOPNL thresholds for each country. Reconstituted nutrient content for instant cereals was calculated as per manufacturers' instructions.

Results: In the UK and UAE, 7.5% and 13.3% of CPCFs, respectively, warranted a warning sign for high levels of sugar/salt/saturated fat/fat, and 59.1% and 56.3% for moderate levels. In Chile, 45.2% of CPCFs warranted a warning sign for high levels of sugar/saturated fat/energy/sodium. In Mexico, 45.3% of CPCFs warranted a warning sign for high levels of added sugar/saturated fat/trans fat/energy/sodium. In Brazil, no CPCFs were found to contain high levels of saturated fat or sodium; however, added sugar content was not declared on any Brazilian labels and could therefore not be evaluated. Across all countries, excessive sugar content was the most prevalent reason for a warning sign, and snacks/finger foods were the most common products to warrant warning signs.

Conclusions: A substantial proportion of CPCFs evaluated in this study contained excessive levels of nutrients of public health concern that would warrant a warning label. Use of FOPNL among CPCFs would allow for clear and easy interpretation of the nutritional suitability of products for infants and young children and encourage reformulation of CPCFs to reduce concerning levels of nutrients like sugar and sodium.

Keyword: front-of-pack nutrition labelling, complementary feeding, infants and young children, ultra-processed foods

Conflict of Interest Disclosure: None.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-85
The influence of the nutrition model on the parameters of body composition

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Background and objectives:

A key element of soldiers' readiness for tasks is their physical fitness, which is in correlation with their body mass, which in turn is a determinant of proper functioning of the body. In military units and other structures utilizing mass catering, proper control of caloric supply, as well as the content of macro and micro components in food is a guarantee of maintaining health, correct body weight, and desired physical fitness. Observation shows that some participants of such catering adopt their own standards and – resigning from mass catering – compose meals at their own discretion. The purpose of this study is to see if this significantly affects body composition parameters: BMI (Body Mass Index), PBF (Percentage Body Fat) BF (Body Fat).

Methods:

Two sources of observation were used:

- the measurement of body composition,
- the records from a program used for keeping track of the meals served.

The collected observations were mathematically analyzed, broken down into the group nurtured in military canteens and the group giving up such nurturing. Basic descriptive statistics were calculated, and then the conformity of the distributions within groups to the normal distribution (Lilliefors test) and homogeneity of variance (Brown-Forsythe test) were examined. Finally, using the Anova analysis of variance or the Kruskal-Wallis test, it was checked whether the diet significantly affects the body composition parameters studied.

Results:

For each type of meal, it was calculated whether the differences between the selected parameters of body composition differ significantly in the groups that participate in collective nutrition and that eat independently. An appropriate statistical test was selected for each study. It turned out that the differences in each group are statistically significant, so the nutrition model affects the value of BMI, PBF and BF. Moreover, in the group that feeds on its own, the mean values of these parameters were much higher.

Conclusions:

The study found significant effects of diet on PBF, BMI and BF levels. The results obtained show that well-balanced food served as part of mass catering favorably affects the body composition parameters and, consequently, the health of the subjects.

Keyword: nutrition model, mass catering, body composition, armed forces, military education

Conflict of Interest Disclosure: The authors declares that there is no conflict of interest

Further Collaborators: The authors do not have any further collaborators other than those entered in the "Authors" section.

PAB(T5)-86
Factors Affecting the Application of Cultural Competence of Clinical Dietitians from Selected Urban Tertiary Hospitals in the Philippines on Diabetes Care and Education

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Background and Objective: The dynamics between culture, food and diabetes is an important process which affects and is essential in the promotion of an individual's health and well-being. In the provision of diabetes care and education, focused questions with regards food preferences, habits and choices are not enough. The concept of cultural competence inbased on the classic Campinha-Bacote model, means recognizing and forming one's attitudes, beliefs, skills, values, and levels of awareness to provide culturally appropriate,respectful, and relevant care and education. Applying it on diabetes care and education, the competencies of clinical dietitians in translating their management and recommendations to mitigate complications of diabetes reflect their cultural competence.

Methods: Using an unstructed questionnaire based on the Cultural Competent Assessment Tool, four clinical dietitians were invited for in-depth interviews from JCI-accredited urban hospitals.

Results: Results showed that clinical dietitians in the chosen four hospitals have partial practice and application of cultural competence in their approach on clinical nutrition and counseling for diabetes. Some of the identified enabling factors are: in place hospital policies, initiatives on professional training and capacity building on clinical nutrition, initiatives of lessening the effects of limited FEL and food models, the availability of translators to answer possible gaps brought about by language barrier and a good follow up package for follow up for continuity of care. Some of the limitations or obstacles in the applying cultural competence are: full understanding of what is cultural competence among clinical dietitians, the lack of National or Standardized guidelines on clinical nutrition and counseling for diabetes, the inappropriate use of FEL for non-Filipino patients, use of western-based food models, and for some lack of basic skills on counseling and patient encounters for establishing rapport

Conclusions: Standardized guidelines on clinical nutrition and counseling for diabetes need to be culturally sensitive in order to continually maintain the identified enabling factors and lessen the obstacles identified in diabetes care and education.

Keyword: Diabetes Counselling, Diabetes Education, Cultural Competence

Conflict of Interest Disclosure: none

Further Collaborators: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T5)-87
Efficacy of a nutrition lecture on dietary basics for athletes: protocol of a randomized controlled trial

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Background and objectives: Nutrition education is essential for supporting athletes performing at a high level. However, no reports of randomized controlled trials have verified the efficacy of nutrition education for athletes. This study aimed to examine the efficacy of a nutrition lecture on the dietary basics for athletes.

Methods:This study is a 1-month parallel-group randomized controlled trial. The study protocol was registered in the University Hospital Medical Information Network Clinical Trials Registry (UMIN000048617) on August 7, 2022. We conducted this trial at the University of Tsukuba Football Club. The inclusion criteria are 1) male and female university students aged 18–30 years, 2) members of a university sports club, and 3) dedicated to sports activities. The exclusion criterion is receiving continuous nutritional support (such as nutrition lectures or consultations with a nutritionist more than once a month). A total of 62 football athletes will be randomly assigned (1:1) into an intervention or a control group with stratification by sex. The intervention group will be provided with a single nutrition lecture and educational materials. The control group will undergo no intervention. The follow-up period is 1 month. The primary outcome is the Japanese Food Guide adherence score. The secondary outcomes are energy and nutrient intake, nutritional knowledge, and stages of changes in eating behavior.

Results: We will report the results of this trial after the data collection in September 2022.

Conclusions: The results obtained from this study will contribute to the nutrition management of top athletes.

Keyword: study design, soccer, college athletes, sports nutrition, nutritional behavior

Conflict of Interest Disclosure: The authors have nothing to declare.

Further Collaborators: Masaaki Koido, Shinsuke Tamai, Risa Mitsuhashi, Aya Sakuma, Yutong Shi, Jiawei Wan, Ryota Hayakawa

PAB(T5)-88
The effect of the nutrition education on knowledge and attitudes for dialysis nurses

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Background and objective: Hemodialysis patients often suffer from protein and energy malnutrition. The aims of the study was to use literacy activities to enhance the effectiveness of nutrition care for dialysis nurses.

Methods: Forty eight participants were engaged in this study. All subjects were divided into two groups. 19 individuals were in the active group and 29 individuals in the control group. A serial of nutrition care training courses for dialysis was held from Feburary to April in 2021. The topics of the training courses were including protein, energy and electrolytes (sodium, potassium and phosphorus) requirements in dialysis patients. The knowledge questionnaires of each activity were conducted before and after course intervention. Test results were collected and scoring. Data was analyzed by using Mann-Whitney test to assess the effectiveness of the course intervention.

Results: This study has showed that intervention of dialysis nutrition care training course significantly improved the knowledge and attitude of participants. The difference is significant at $p < 0.001$ level .

Conclusions: The results show that the intervention of nutrition education can effectively improve nutrition knowledge, achieve behavior change, and strengthen the ability of nutrition care. Nursing staff become able to provide simple nutrition education to dialysis patients after intervention. The lack of long-term training courses resulted in poor outcome. Further education stragies in formulating a long-term plan is necessary.

Keyword: dialysis , nutrition education, malnutrition

PAB(T5)-89
A Questionnaire Survey of infant and toddler facility staff regarding their interest in and understanding of “Shokuiku”

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Background and objectives: Nutrition education activities for children, who will be responsible for the future generations, are important, and the Global Nutrition Target 2025 also calls for activities related to infant nutrition. Therefore, this study focused on infant and toddler facility staff, who are among the

most important people in the lives of infants and toddlers. This study aimed to understand the perception of infant and toddler facility staff toward nutrition education, with the objective of further promoting nutrition education activities for infants and toddlers. This was done by examining the influence of the staff's interest in nutrition education on their perception of nutrition education.

Methods: In February 2021, an online survey questionnaire (Google Forms) was sent to 110 infant facilities listed in the 2020 Infant Facilities Guide, published by the city where the researcher's facility is located, and 204 responses were obtained. The level of interest and perception of nutrition education were examined by creating two groups of participants: the participants that responded "interested" (111, 54.4%) as the high-interest group, and the participants that responded, "somewhat interested" (89, 43.6%) and "somewhat uninterested" (4, 2.0%) as the low-interest group.

Results: The high-interest group tended to be older than the low-interest group ($p<0.001$) and to have spent more time working at the infant facility ($p<0.001$). The percentage of respondents who answered that they knew both the definition and content of "Shokuiku" tended to be greater in the high-interest group ($p<0.001$). When the perceptions of nutrition education were compared between the two groups, there was no significant difference in response trends between them regarding daily meals and table manners. The high-interest group was significantly more likely to select "health achieved through food and distribution of food" as nutrition education ($p<0.05$). Additionally, the high-interest group selected the "effects of nutrition education on the family and the body" more often than the low-interest group ($p<0.05$).

Conclusions: The high-interest group demonstrated a broader view of nutrition education and activities than the low-interest group, and it is possible that the high-interest group expects more benefits from nutrition education than the low-interest group.

Keyword: Shokuiku, Nutrition education, Infant and toddler facility staff

Further Collaborators: This work was supported by JSPS KAKENHI Grant Number JP20K13964.

PAB(T5)-90
Does the nutrient content of school meals vary by types of cuisine? Findings from a pilot study in California.

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Background and objectives. More than 30 million of children in the U.S. receive at least one school meal every day. School meals offer an excellent venue for providing exposure to diverse food cultures as well as healthy foods and shaping students' dietary patterns and eating habits. The current study examined the diversity of cuisine served in school meals and the nutrient content by the types of cuisine in one of the most diverse and populous states in the U.S.

Methods. We selected 27 public schools (9 each for elementary, middle, and high schools) in San Francisco School District and analyzed the school menus on March 14, 2022 through June 1, 2022. We categorized entrees by the associated racial/ethnic types of cuisines.

Results. The selected schools had high proportions of Hispanic/Latino and Asian students (mean = 40, 31, 35% and 21, 38, and 37% in elementary, middle, and high schools respectively). Over eighty percent of the entrees offered were American cuisine such as burgers, mac&cheese, and hot dogs while the remaining entrees offered were from Asian and Mexican or Latin American cuisines. While the average calories were similar across all cuisine types for each school level, fat and sodium content were much lower in Asian cuisine entrees. The average total fat was 3.1g (SD 1.9), 6.4 (4.2), 4.0 (1.7) for Asian entrees in comparison to American (12.3 (6.7). 12.9 (7.3),14.4 (7.1)) and Mexican (11.4 (3.8), 11.0 (3.2), 11.4 (2.8)) entrees for elementary, middle, and high schools respectively. Carbohydrates were higher in Asian entrees than other types of entrees.

Conclusions. The types of the cuisine served in those schools are less diverse than the racial/ethnic compositions of the student body. The most commonly served cuisine had, on average, poorer nutritional profiles of the meals than Asian entrees. Future studies are needed to examine association of diversity of school meals and diet quality, nutritional knowledge, as well as nutritional status among schoolchildren.

Keyword: School nutrition, Children, School meals, Diet, Diversity

Conflict of Interest Disclosure: None.

Further Collaborators: None.

PAB(T5)-91
The Effect of Athletic Discipline and Nutrition Support Experience on Nutrition Knowledge Proficiency among College students in Physical Education

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Background and Objectives: Knowledge of "sports nutrition" is essential for improving athletic performance. However, although lectures on nutrition are given in many settings, there is a paucity of instruction tailored to the unique characteristics of each sport's competition, and little research has been conducted on the educational effectiveness of such instruction. The purpose of this study was to examine the effects and relationships of a test of basic sports nutrition knowledge and a questionnaire on previous sports nutrition support

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

experience and specialized athletic events on the level of proficiency in nutrition knowledge among college students in physical education who are engaged in sports activities.

Methods: A total of 152 participants, eighty-eight college students specializing in team sports (e.g., ball sports events) and 64 college students specializing in individual sports (e.g., martial arts, swimming, athletics), were surveyed using two types of tests and questionnaires. The test consisted of 50 questions regarding basic knowledge of sports nutrition. The questionnaire surveyed the subject's profile, athletic life, and support experience in sports nutrition. IBM SPSS (Version 27.0 IBM) was used for statistical analysis with a significance level of 5%.

Results: An analysis of variance was performed on the test scores, with "sports category" and "experience with nutrition lectures prior to college" as the two factors. Since significant interactions were found, simple main effects of each factor were examined. The results of the simple main effect test showed that among college students who "had experience with nutrition lectures before entering college," those who specialized in individual sports showed significantly higher values than those who specialized in team sports. The results were also significantly higher for college students specializing in team sports who reported "no" experience with nutritional lectures than those who reported "yes" experience.

Conclusions: Regarding college students who had experience supporting sports nutrition, it was thought that they who specialized in individual sports were more likely to retain their knowledge than those who specialized in team sports. However, for college students who specialized in team sports, lecture experience may not necessarily lead to future knowledge retention.

Keyword: sports nutrition, nutritional knowledge, college athlete, nutritional education, physical education

Further Collaborators: Megumi Matsumoto, Department of Education (Physical Education Course), Graduate School of Letters, Nihon University.

PAB(T5)-92
A Discussion on the Effect of Using Life-Oriented Nutrition Courses to Enhance Employee Weight Loss

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Background and objectives: Healthy workplaces are able to help reduce health-related hazards for employees and enhance their overall corporate competitiveness. In order to encourage employees to maintain healthy postures, courses may be designed for weight-loss diets and exercise. The purpose of this study is to design courses for weight-loss diets and exercise in order to improve the effectiveness of employee weight-loss activities and create a healthy workplace with healthy employees.

Methods: A total of 55 participants with BMI≧24 or body fat percentage ≧30% were accepted into the 12-week course. During this period, weight-loss and nutrition classes were held on the six main categories of food, low carbohydrate diet, tips for eating out, and selection of snacks/supplement during exercise. A sports coach also led aerobic exercise activities once a week and the participants were encouraged to maintain the habit of daily independent exercise. The data collected includes measurements of pre- and post-course BMI, body fat percentage, body weight, and waist circumference as well as a curriculum satisfaction questionnaire. The survey results were compared using the Student's *t*-test analysis.

Results: During the activity, 30 participants were excluded from the results due to their inability to cooperate with the process. A total of 25 participants completed the post-course test, including 23 females and 2 males. After 12 weeks, average body weight decreased by 1.9 kg, and overall average body fat percentage levels decreased by 1.1%. The analysis showed that body weight, body fat percentage, waist circumferences and BMI were significantly decreased in the before and after comparison (P<0.0001).

Conclusions: Holding weight-loss competitions for employees together with weight-loss nutrition and exercise courses can help employees lose weight and improve their overall health.

Keyword: Weight loss, Workplace health promotion, Low carbohydrate diet

PAB(T5)-93
Utilization and outcomes of visual aids (my nutrition calendar and food model)

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Background and objectives: The Japan International Cooperation Agency (JICA) technical cooperation project "Improvement of Maternal and Child Health and Nutrition" conducted activities to improve malnutrition of pregnant women and infants in Quiche, Republic of Guatemala, from 2016 to 2021. The purpose of this course was to provide nutrition education that promotes changes in the awareness and behavior of the target residents themselves through the development and practical use of visual aids that consider the food culture of the target area.

Methods: Food models of menu examples for pregnant women and infants from early pregnancy to 2 years old were prepared, deployed in health care facilities, and used during nutrition guidance. The same nutrition and hygiene guides were made into wall-mounted calendars and distributed to pregnant women and infant households. In the end-line survey at the end

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of the project, a KAP survey was conducted on pregnant women and mothers of children under 2 years of age.

Results: Awareness and knowledge of nutrition and hygiene were improved by the individual use of visual aids with food guides and photographs showing examples of menus in line with dietary intakes during pregnancy and infant life and the amount of increase in mid-to-late childhood, and teaching materials with illustrations of nutrition and hygiene guides that consider culture and customs. In the end-line survey, 84.4% of respondents said they would "increase the amount of food they eat" when asked what they should eat appropriately during pregnancy.

Conclusions: The development and use of culturally conscious nutrition materials, visual aids incorporating illiterate drawings and photographs will contribute to the improvement of nutrition improvement activities.

Keyword: Visual aids, Maternity nutrition, Infant nutrition, Hygiene and nutrition improvement, Food guide

PAB(T5)-94
Editathon: a pilot event and model to support engaged, public health learning

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Background and objectives: The 2021 Wikipedia pilot event *Editathon: "Health for All"* was launched to assess the feasibility of conducting an international, fully virtual Wikipedia editathon. Conducting such work enabled an evaluation of the validity of the information being provided to the public while also assessing the health community's interest in participating in knowledge translation campaigns.

Methods: The pilot event *Editathon: "Health for All"* was a fully online hybrid event, with synchronous and asynchronous session, conducted throughout a four-day period. Volunteer editors and topic experts reviewed, updated, and created articles related to topics of human health and nutrition. Branding and dedicated communication venues were created by the event's organizers to ease communication among participants. Wikimedia was notified of the event to ensure the permanent publication of the articles edited during the event.

Results: The event was deemed to be successful. All the benchmarks of the quality assessment were met or surpassed. Furthermore, positive feedback was received from participants who expressed the desire to implement and promote similar initiatives among college students.

Conclusion: The pilot event *Editathon: Health for All*, was successful in demonstrating the feasibility of sustaining an international collaborative hybrid event with synchronous and asynchronous sessions. Positive feedback was received from participants about the experience.

Keyword: Nutrition, Editathon, Wikipedia, Nutrition Education, Knowledge Translation

Conflict of Interest Disclosure: None to declare

PAB(T5)-95
Traditional and modern fast food consumption patterns and associated factors among adolescents and young adults in Hanoi, Vietnam

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Background and objectives: Vietnam is undergoing a nutritional transition due to the rapidly growing economy. With the influx of foreign food companies, the country's food landscape increasingly includes highly processed food such as fast food, especially among young people. Whilst having a well-entrenched culture of street food that similarly offers convenience, there is a paucity of literature on traditional fast-food consumption. Due to the increasing rate of diet-related chronic disease in the country, this study sought to understand young people's consumption and associated factors with modern and traditional fast food.

Methods: A cross-sectional online survey of 371 young people was conducted in Hanoi, Vietnam in May 2020. The samples comprised adolescents (aged 15-18) and young adults (aged 19-25) from two randomly selected high schools and two pre-selected universities respectively who provided information on fast food consumption and potential factors associated with it (e.g. proximity to fast food outlets, friends/colleagues'' influence on fast-food purchase, the influence of fast food advertising, exposure to fast food advertising, fast-food related nutrition knowledge). Generalised linear mixed models, with the school as a random effect, were used to explore factors associated with frequent (daily) fast food consumption.

Results: Almost three-quarters of total respondents reported consuming at least one fast food meal item weekly or more often. A greater proportion of the respondents reported consuming traditional style fast food meals (64%) weekly or more compared to modern fast-food meals (33.5%). Males were more likely to be daily consumers of fast food overall, which remained for traditional or modern types. A lack of knowledge on health and disease risks is strongly associated with greater consumption of fast food overall ($p < 0.05$). Additionally, females were significantly more knowledgeable of health risks associated with fast food consumption compared to males ($p < 0.05$). **Conclusions**: Intervention to reduce fast food consumption should target young males with a strong emphasis on education

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

about health and disease risks associated with frequent consumption of fast food.

Keyword: Fast food, Adolescent, Young people, Vietnam
Conflict of Interest Disclosure: None

PAB(T6)-1
Food and beverage combinations, patterns among Swedish Adolescents

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Background: It has been shown that food and beverage combinations can be used as indicators of healthy meal patterns. Even though choices of combinations often are considered subjective properties in some part, and have been studied in several different ways, mainly within the field of sensory science on adults, this study contributes to the field of food and beverage combination studies by using self-reported habits on adolescents.

Objective: This article explores the relationships between food and beverage combinations, recorded by a Swedish adolescent population.

Method: Secondary analyses were made using data from the national dietary survey, Riksmaten Adolescent (2016-2017), performed by the Swedish Food Agency. A total of 3 477 Swedish adults aged 11, 15 and 18 years old contributed dietary intake data. Participants in the survey registered 3 days of intake where recall day one and three were non-consecutive and retrospective. All meal choices were categorized into beverage categories and food categories. Combinations between beverage and food categories were analyzed by using cross tabulation. Correlation coefficients for non-parametric variables were used to determine the association power. Predictive factors for more important beverage and food combinations were explored by logistic regression analysis.

Results: Our results show correlations in reported consumption of food and beverage, which explain the occurrences of specific patterns of combinations of food and beverages

Conclusion: More studies on choice of beverage are needed to describe the patterns of intake, in order to understand the mechanisms behind beverage choice, in different settings and cultural situations and lifestyle backgrounds. Combinations in everyday life are described here and are rather building on availability than on optimal taste combinations. Our findings can offer an understanding of some common every-day choices as habits which are of concern for future meal patterns.

Keyword: Drink, Meal, Consumption, Food habits, National dietary surveys
Conflict of Interest Disclosure: None

PAB(T6)-2
Workplace Health Promotion by "My Plate"

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Background and Objective: People in Taiwan suffers from nutritional deficiency according to the surveys conducted by the Ministry of Health and Welfare (MHW). In the previous publication of the daily dietary guidelines, the guidelines were visualized in a pie chart. MHW did not get the anticipated response and issued a new format using a plate ("My Plate") as a visualization with mnemonics to submit valuable nutrition lessons to memory and practices. To further promote healthy diet, MHW hosts workshops in various workplaces.

Methods: "My Plate" is based on the daily dietary guidelines published by the Ministry of Health and Welfare. "My Plate" visualizes the serving size for the 6 major categories of food. This allows the public to eat a variety of local food while consuming balanced nutrition proportional to "My Plate". Changhua Christian Hospital partners with the Central Health Workplace Center to promote "My Plate" in various workplaces. To assess the effectiveness of the workshops, participants were given the pre and post-tests.

Results: Based on the 146 pre and post-tests results from four different workshops, the level of understanding for the daily dietary guidelines was increased by 47.26% (from 44.06% to 91.32%) after the workshops. In addition, the level of understanding for the serving size was increased by 23.97% (from 72.95% to 96.92%). Further, the level of understanding for "My Plate" was increased by 67.12% (from 17.81% to 84.93%).

Conclusions: Per the analysis mentioned above, it is clear that the health and nutrition workshops at workplace can significantly impact people's dietary decisions, effectively promote national health policy, and most importantly, enhance overall public health in Taiwan.

Keyword: healthy-promotion, healthy-care, myplate, nutrition, dietary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-3
Regional differences in food choice priority and related social and environmental factors in Japanese schoolchildren

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Background and aims: After the 2011 Great East Japan Earthquake, interest in food choice might increase in Japan. In this study, we examined guardian's food choice priority for their children after the earthquake, and also revealed background factors related to food choice priority.

Methods: We administered a comprehensive questionnaire survey on schoolchildren's diet and health and on their guardians between November 2015 and March 2016. Nine elementary schools in the northern and southern districts in Japan cooperated, as well as 3,327 guardians out of 4,263 enrolees (cooperation rate: 78.0%). We used the completed response data of 3,080 guardians in the analysis. Multivariate logistic analysis was used to assess the association between food choice priority and social background.

Results: The most important factor in children's food was 'safety', which accounted for about 40% of the total. 'Nutrients' were 16%, and 'freshness' was almost 13%. Guardians living in southern area, away from the disaster area, were 1.3 times more likely to consider 'safety' as food choice priority for children. The related background factors of 'safety' were guardian age and employment, the number of family members living together, monthly food costs per person in the family, emotional capacity in life, and guardian's concerns about food education. As age increased, the tendency to place importance on children's food safety increased 2–3 times. Guardians who were uninterested in food education tended not to prioritise food safety.

Conclusion: 'Safety' was the most important concern in children's food among guardians in this study, and the tendency was higher in areas far from the affected area. The result from the related factors, guardians' understanding and knowledge about food might influence food choice for their children. There is a need for detailed research to reveal what is 'safe' in guardians' decision criteria of food choice.

Keyword: food choice, priority, schoolchildren , Great East Japan Earthquake

PAB(T6)-4
Taste investigation of miso soup for the restriction of sodium intake

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Background and objectives: It is known that Japanese foods are healthy, their nutrient balance is good and enrolled in the UNESCO Intangible Cultural Heritage. However, the salt intake of Japanese people has been exceed the target value for a long time. The lowering of salt intake is an urgent problem in Japan, but it is not easy to realize sodium restriction. One reason is that we have a custom to drink miso soup and eat pickles in Japan. Therefore, in this study, after tasting of miso soup, we aimed for exploring everyday sodium restriction method from questionnaire survey.

Methods: Subjects of the survey are 60 Female University students (Response rate 100%) in Tokyo. After tasting of two kinds of miso soup, they replied some questions in the Google form (The unsigned self-entry-style-answer). Both A and B miso soup have 150ml water, 10g miso, 1g powder bonito soup stock (Salinity 1.1%, 60℃). Only B miso soup has 1g dry seaweed. We used the same amount with their food indication. They were standard quantity in Japan.

Results: Which do you feel to be strong? It was A miso soup (A name is Ams) 87%, B miso soup (Bms) 8%. Which is delicious? It was Ams 35%, Bms 57%. Which is similar to home taste? It was Ams 30%, Bms 58%. Are you doing sodium restriction routinely? It was always 12%, sometimes 48%, not doing it at all 32%, did not remember 8%. What is an ingredient material for use in miso soup to cook at home most? It was seaweed 48%, tofu or fried bean curd 30%. What is the soup stock to use most at home? It was dried bonito (48%).

Conclusions: They replied that it was delicious like the home taste that the miso soup of the seaweed was more dilute. In Japan we have healthy custom to put seaweed in miso soup. But we will feel salt low when we put seaweed in it, it may be connected to increase of the miso (Salt intake).

Keyword: Miso soup, Sodium restriction, Salt intake, Seaweed, Taste investigation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-5
Socio-economic factors and eating behavior of children in North Macedonia

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Background and objective: Eating foods that assure health benefits is crucial to minimize diet-related risks for developing NCDs. Diet rich in fruit and vegetables, with appropriate intake of legumes, nuts, and whole grains, and with limited intake of free sugars, salt, saturated and trans fatty acids maintains functioning of the body without increasing of the health risks. Eating habits that promote health adopted in childhood are important component for reduced health risks in adulthood. Objective of our research was to inspect the eating behaviors of second-grade children in North Macedonia and its relation to some socio-economic factors.

Methods: Total of 3246 second-grade children were selected for data collection in the frames of 5th round of the WHO's Childhood Obesity Surveillance Initiative (COSI). Frequency of consumption of fruits, vegetables, soft drinks, savory snacks, and sweet snacks was examined. "Eating habits score" for each child was calculated by converting of each dietary habit (based on consumption frequency) to a "healthy" or "less healthy" behavior. Scores ranged from 0 (indicating a very healthy diet), to 6 (indicating a less healthy diet, where all the "less healthy behaviors" were observed). Gender, BMI, urbanization level, parent's education and participation in sports activity were analyzed in relation to eating behaviors.

Results: None of the analyzed eating habits had a significant impact on BMI categories (underweight, physiological weight, overweight and obesity) in children. In general, 75% of girls and 78% of boys reported consuming breakfast every day but only 40% of children reported consuming fruit and 37% consuming vegetables every day. 63% of children whose both parents have secondary or lower education practiced "less healthy behavior" comparing to 37% of those whose at least one parent has tertiary education ($p<0.001$).

Conclusions: Daily breakfast consumption of children is around the European average but there is much room for improvement in the intake of fruits and vegetables. Most of the children practice neither "healthy" nor "less healthy" dietary behavior. Among different socio-economic factors, only lower level of parental education significantly contributes towards practicing "less healthy" dietary habits

Keyword: eating habits, children, socio-economic factors, Macedonia

Conflict of Interest Disclosure: None

PAB(T6)-6
Antioxidant vitamin intake and LOX-index among a Japanese working population

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Background and objectives: Cardiovascular disease is a major cause of death globally. Lifestyle, including dietary factors, plays a role in the development of cardiovascular disease. Antioxidant vitamins are suggested to prevent the onset of CVD by inhibiting the oxidation of LDL cholesterol and decreasing the risk of atherosclerosis through their antioxidant effect. In a meta-analysis of 15 prospective studies, antioxidant vitamin intake was associated with decreased risk of cardiovascular disease. LOX-index, which is a new predictive index of cardiovascular disease, reflects the state of atherosclerosis. However, no study has examined the association between antioxidant vitamin intake and LOX-index. This study investigated the association between antioxidant vitamin intake (vitamin A, vitamin E, and vitamin C) and LOX-index in a Japanese working population.

Methods: Participants were 346 workers (171 men and 175 women aged 19-71 years) without a history of serious disease. Antioxidant vitamin intake was assessed using a brief-type self-administered dietary history questionnaire (BDHQ). LOX-index was calculated by multiplying the soluble form of Lectin-like oxidized LDL receptor 1 (sLOX-1) by LOX-1 ligands containing apolipoprotein B (LAB). Multiple regression analysis was used to estimate the geometric mean of the LOX-index according to tertile of intake of each antioxidant vitamin.

Results: Vitamin A intake was suggestively associated with lower LOX-index. The geometric mean (95% confidence interval) of the LOX-index for the lowest through highest tertile of vitamin A intake was 716 (617-832), 650 (560-754), and 580 (500-674) after adjustment for age; sex; BMI; job grade; overtime work; smoking; alcohol drinking; sleep duration; leisure-time physical activity; sedentary time during work; total energy intake; history of diabetes, hypertension or dyslipidemia; use of supplements; systolic blood pressure; fasting blood glucose; and LDL cholesterol (P for trend = 0.055). The geometric mean of LOX-index tended to be lower with increasing intake of vitamin C and vitamin E, although the inverse association was not statistically significant. The inverse associations between vitamin A, vitamin C, and vitamin E intake and LOX-index were more pronounced in women.

Conclusion: Our results suggest that vitamin A intake was associated with a lower LOX-index in this working population.

Keyword: LOX-Index, Antioxidant Vitamin, Antioxidant Effect, Cardiovascular Disease, Working Population

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-7
Relationship between food production experience and adherence to dietary guidelines among Japanese adults: a cross-sectional study

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Background and Objectives: The Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF) has identified increasing the percentage of the population who experienced food production as one of the objectives of the Basic Program for Shokuiku (Food and Nutrition Education) Promotion. This study aimed to clarify the relationship between food production experience and adherence to dietary guidelines among Japanese adults.

Methods: This is a cross-sectional study conducted using the data of the "Survey on dietary habits and food production experiences in 2019" carried out by MAFF. The independent variable was food production experience. The dependent variables were each of the 13 goals of the dietary guideline in Japan and an aggregate score for adherence to the 13 goals (low score means good adherence). Additionally, we examined the association between which point on the life course the food production experience took place and adherence to dietary guidelines. The data of 3461 participants in their 20s–60s were used. For the analyses, multivariate logistic and linear regression analyses were used.

Results: Upon considering those who had not experienced food production as a reference, it was noted that the adherence was significantly better for 11 of the 13 goals when the participants had experienced it. In the linear regression analyses with an aggregate score for adherence as the dependent variable, when the participants were not experienced food production as the reference, B = −1.496 ($p < 0.001$) when the participants experienced it. Among the life courses, the experience in adulthood was significantly associated with the aggregate score for adherence (B = −1.556, $p < 0.001$). Experience when underage (less than elementary school, and elementary school or more) was only moderately related (B = −0.459, $p = 0.085$; B = −0.684, $p = 0.080$).

Conclusions: This study revealed that food production experience was positively associated with adherence to dietary guidelines in Japan. Particularly, there was a strong association with experiences in adulthood.

Keyword: food production experience, dietary guideline, life course, food and nutrition education, Japan

PAB(T6)-8
Hypertension and Obesity Are as Mediators from Early Menarche to Coronary Artery Disease: Mendelian Randomization Study

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Rationale: Earlier age at menarche leads to the risk of coronary artery diseases; however, the risk is thought to be mediated through metabolic risk factors and may not be caused by earlier age at menarche directly. **Objective**: To investigate the role of body mass index, blood pressure, blood lipid and blood sugar in explaining the effect of earlier age at menarche on the risk of cardiovascular diseases. **Methods**: In the prospective cohort design, we included 1,598 participants from the Chin-Shan Community Cardiovascular Cohort study. Approximately 70,000 participants from Taiwan Biobank were included in the retrospective cohort and Mendelian randomization studies. We used randomly allocated genetic variants for the exposure and mediators in the Mendelian randomization study. We investigated the role of metabolic factors in mediating the causal effect of age at menarche on the risk of coronary artery diseases by using the three complementary approaches with mediation analyses: multivariable cox proportional hazard regression, multivariable logistic regression, and Mendelian randomization. **Results**: Each additional standard deviation of earlier age at menarche was associated with a 56% higher risk (hazard ratio 1.57, 95% confidence interval 1.12 to 2.19) in the prospective cohort study, a 11% higher risk of coronary artery disease (odds ratio 1.11, 95% confidence interval 1.02 to 1.21) in the retrospective cohort study, and a 2% higher risk (1.02, 1.001 to 1.03) in the Mendelian randomization study. For the effect of genetically predicted earlier age at menarche on the risk of coronary artery diseases, 40% was mediated by genetically predicted body mass index and 27% by genetically predicted systolic blood pressure. **Conclusions**: By using distinct analytical methods, including genetic approaches that can draw causal inference, our results suggest that interventions aimed at reducing BMI and SBP would lead to reductions in cases of CAD attributable to earlier age at menarche. Importantly, more than four tenth of the effect of earlier age at menarche on the risk of CAD is not mediated through the two factors and further studies are warranted to investigate this.

Keyword: earlier age at menarche, cardiovascular diseases, mediation, Mendelian randomization

Conflict of Interest Disclosure: no conflict of interest there

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-9
Modeling food fortification contributions to micronutrient requirements in Malawi using Household Consumption and Expenditure Surveys

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Background and objectives: Large-scale food fortification may be a cost-effective intervention to increase micronutrient supplies in the food system when implemented under appropriate conditions, yet it is unclear if current strategies can equitably benefit populations with the greatest micronutrient needs. This study developed a mathematical modeling framework to compare large-scale food fortification scenarios across different contexts.

Methods: The framework was applied to model the potential contributions of three fortification vehicles (oil, sugar, and wheat flour) towards meeting dietary micronutrient requirements in Malawi through secondary data analyses of a Household Consumption and Expenditure Survey. We estimated fortification vehicle coverage, micronutrient density of the diet, and apparent intake of nonpregnant-nonlactating women for nine different micronutrients, under three food fortification scenarios and stratified by subpopulations across seasons.

Results: Oil and sugar had high coverage and apparent consumption that, when combined, were predicted to improve the vitamin A adequacy of the diet. Wheat flour contributed little to estimated dietary micronutrient supplies due to low apparent consumption. Potential contributions of all fortification vehicles were low in rural populations of the lowest socioeconomic position.

Conclusions: While the model predicted large-scale food fortification would contribute to reducing vitamin A inadequacies, other interventions are necessary to meet other micronutrient requirements, especially for the rural poor.

Keyword: large-scale food fortification, HCES, micronutrient inadequacy, equity

Conflict of Interest Disclosure: The author declare no competing interests.

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PAB(T6)-10
Responsive maternal feeding behaviors used with young children in Perú

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Background and objectives Responsive feeding behaviors are related to the development of healthy eating behaviors in young children. There is evidence that positive interactions between the caregiver and child during feeding episodes can reduce malnutrition. The aim of this study was to identify dimensions of responsive feeding, and whether this varies based on the age of the child, in families living in a Peruvian city. **Methods** Eight mothers with a 6-23-month-old child, living in peri-urban areas of Huánuco - Peru, participated. Following informed consent, observations of the mother-child dyad were conducted in the family's home. The observations were carried out during January and February 2020, with an average duration of five hours, including meal preparation and mealtimes. Previously validated guides were used to code the observations, specifically examples of responsive and non-responsive feeding behavior. **Results** Mothers were differentiated according to the age of their children: 6 to 12 months of age (mean 9.6 months) and 13 to 23 months of age (mean 18.2 months). Mothers of children aged 6 to 12 months commonly demonstrated responsive behaviors that included responding to the child's feeding signals and using strategies to try to encourage their child to eat the food. Non-responsive behavior in this group was identified as not giving the child opportunities to eat on their own, because some mothers were afraid that the child would choke, get messy or were too slow. Mothers of the 13 to 23 month-olds gave their child more opportunities to eat by themself with their hands or spoon. However, talking to the child during meals was practically absent and some mothers were more controlling, exerting various forms of pressure at mealtimes. **Conclusion** Greater responsive feeding behavior was evident in mothers of younger children compared to mothers of older children. This likely reflects mothers allowing their older children greater autonomy in eating whilst engaging in fewer vocalizations at mealtimes, but also reflects greater use of pressure for older children to eat. Support is recommended to inform parents about the unintended effects that can arise from overly-controlling feeding practices and the benefits of verbalization during feeding.

Keyword: infant feeding, responsive feeding, pressure to eat, maternal feeding behavior, children's eating

Conflict of Interest Disclosure: no conflict of interest

Further Collaborators: does not correspond

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-11
Changes in food consumption and body weight during the COVID-19 pandemic

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Background and Objectives: During the COVID-19 pandemic, people around the world made major changes to their lifestyle to prevent the spread of the disease. This study aimed to examine the relationship between changes in food consumption and body weight during the COVID-19 pandemic.

Methods: A cross-sectional questionnaire survey was conducted via the internet in November 2020 among 6,000 Japanese adults (aged 20–64 years) who were registered with a research company. The questionnaire included items on demographic characteristics, body weight before (November, 2019) and during (November, 2020) the pandemic, changes in food consumption (quantity of vegetable intake; frequency of intake of rice, bread, noodles, fruit, meat, fish, milk, dairy products, instant food, fried food, and confectioneries), and changes in duration (number of hours) of exercise and sleep after the COVID-19 pandemic began. Multinomial logistic regression analysis using a stepwise method was performed to analyze the relationship between changes in food consumption and body weight during the pandemic. The reference group included individuals whose weight had not changed. The demographic characteristics, pre-pandemic body weight, and changes in duration of exercise and sleep were included the analysis as adjustment variables.

Results: Of the 5,981 respondents, after excluding invalid responses, 308 respondents (5.1%) had a 5% or more decrease in body weight and 321 respondents (5.4%) had a 5% or more increase in body weight, and 5,352 respondents (89.5%) experienced no changes in weight. All food consumption changes were found to be associated with weight change. Results of the multinomial logistic regression analysis showed that people who had a weight loss of 5 % or more were more likely to have decreased the frequency of rice and fried food intake. On the other hand, people with weight gain of 5 % or more were more likely to have increased their frequency of rice, fried food, and instant food intake.

Conclusions: A decrease in frequency of rice and fried food intake is associated with weight loss, and an increase in frequency of rice, fried food, and instant food intake is associated with weight gain during the COVID-19 pandemic.

Keyword: weight change, food consumption, COVID-19

Conflict of Interest Disclosure: All authors declare no conflict of interest.

PAB(T6)-12
Indian fathers' perceptions of early childhood care and feeding: A qualitative inquiry

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Background and objectives: The role of fathers in child rearing and feeding has been largely overlooked in the paediatric literature, more so within the LMIC context. The emergence of nuclear families and the rise in female employment in urban India underscores the need to explore the involvement of Indian fathers in child rearing. A greater understanding of fathers' views regarding their participation in child rearing is warranted to inform the development and implementation of effective family-based interventions to promote dietary health and well-being in children while mitigating the risk of double burden of malnutrition. This present inquiry aimed to describe Indian fathers' perceptions of child rearing.

Methods: Convenience sampling was employed to recruit 22 fathers of children aged 6-59 months from Kolkata city, India. In-depth, semi-structured interviews were conducted over Zoom/telephone in Hindi, Bengali, and English. All interviews were recorded, transcribed verbatim and translated to English. Transcribed data were analysed both manually as well as through NVivo software program. Ethical approval for this qualitative study was granted by the Institutional Ethics Committee of Banaras Hindu University (Dean/2021/EC/3006).

Results: A number of themes were identified during thematic analysis which included (i) Limited engagement of fathers in feeding; (ii) Adoption of a variety of feeding practices e.g. pressuring the child to eat, incentivizing food consumption, making healthy foods available, using food to bond with the child; (iii) Active engagement of fathers in physical activity and vaccination of children; (iv) Child rearing as a responsibility of both parents; (v) Challenges to routine involvement of fathers in childcare; (vi) Lack of awareness about dietary requirements of children; (vii) Need for emphasizing adequate diet and physical activity in children.

Conclusions: The emerging findings provide novel insights about Indian fathers' experiences associated with childcare and feeding in the rapidly transforming Indian society. All fathers strongly endorsed the need for inculcating healthy eating behaviours and physical activity in formative years for the optimum growth and development of children. This growing understanding of paternal child rearing practices potentially triggers support for father involvement in diet-related interventions and efforts.

Keyword: Fathers, India, Interviews, Childcare, Feeding

Conflict of Interest Disclosure: None

Further Collaborators: NA

PAB(T6)-13
Elevating self-reflection on SMART eating in Sri Lankan adults using a meal tracking smartphone app

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Background and objectives: SMART eating interventions to reduce the consumption of unhealthy food and increase the consumption of a variety of healthy food is one of emerging strategies to combat non-communicable diseases worldwide. In this milieu, using photo-based food journaling to amend eating behaviours has become an up-and-coming strategy. Hence, investigating the effect of photo-based food journaling for self-reflection on SMART eating is timely. The purpose of this study was to explore the effect of photo-based food journaling on meal tracking experience, self-reflection, and self-assessment on SMART eating, and food choice intention in adults while developing a novel meal tracking application named SnaT (Snap & Track) in the Sri Lankan context.

Methods: Using sequential explanatory mixed-method, a convenient sample of 25 adults completed a photo-based food diary for three days, followed by additional three days using the SnaT meal tracking app. All the data were collected via telephone interviews in August 2021.

Results: The mean age of participants was 24±6.08 years, and 80% of participants were female. There was a significant increase in the consumption of a variety of healthy food [fruits and vegetables (p=0.00), legumes (p=0.001), fish, meat and poultry (p=0.00), eggs (p=0.00), and milk (p=0.001)] and a decrease in unhealthy food consumption [salt (p=0.025), sugar and sweet food (p=0.00)]. Busy lifestyle was identified as the primary challenge for SMART eating and 76% (19/25) accepted photo-based food journaling as a remedy to improve it. Enhancing the self-awareness on meals was the major benefit of photo-based food journaling (18/25; 72%) while forgetting to capture photos before eating was the main barrier (17/25; 68%). Nonetheless, SnaT was accepted (21/25; 84%) as a meal tracking app that is appropriate to Sri Lanka and has proven to reduce the burdens inherent to manual photo-based food journaling.

Conclusions: Photo-based food journaling showed a significant impact on SMART eating, and the acceptance of SnaT to facilitate photo-based food journaling was satisfactory. However, future studies should warrant evaluation of the SnaT on different demographic groups by redesigning the app to include features of digital nutrition education and nudging techniques to prompt and promote healthy eating.

Keyword: Meal tracking app, Photo-based food journaling, SMART eating, Self-reflection, Adults

PAB(T6)-14
Factors associated with Iron Deficiency Anaemia among Pregnant Women in Ifako Ijaiye, Lagos, Nigeria

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Background and Objectives: Maternal iron stores is critical to maternal health and good pregnancy outcomes. However, little is known on factors associated with iron deficiency anaemia (IDA) in pregnancy, in light of the growing burden of maternal mortality and poor pregnancy outcomes, particularly among women from low- and middle-income countries (LIMCs). This study assessed sociodemographic factors associated with IDA among pregnant women in Ifako-Ijaiye Lagos, Nigeria.

Methods: Sociodemographic information were assessed among 432 singleton pregnant women (without pre-existing medical complications) using a pre-tested questionnaire, and finger pricked blood samples were taken into capillary tubes to determine haemoglobin (Hb) concentration in g/l using the haemoglobin-cyanide technique. According to the World Health Organization criteria, IDA among pregnant women was defined as Hb < 110g/l, chi-square test or t-test was used to compare categorical and continuous variables respectively according to IDA status at a 2-sided *P*< 0.05.

Results: Mean age of respondents was 28.5±4.6years, 203 (47.3%) had at least secondary education, 4.6% were never married, and 29.2% earned less than N16,000 monthly. The average gestational age was 31 weeks, 47.7% were primigravidae, and 83.8% had IDA (Hb < 110g/l). Similarly, mean Hb concentration was lower among pregnant women with IDA (94.3±10.6g/l) than those without IDA (116.7±5.5g/l). Age, gestational age, educational status and marital status differed insignificantly by IDA status. However, the prevalence of IDA was higher among pregnant women who were primigravidae – 87.9% (compared to multigravidae pregnant women – 80.1%) and those who earned more than N16,000 monthly presented a higher prevalence of IDA (79.4%) than those who earned less than N16,000 monthly (57.1%).

Conclusion: IDA was prevalent in this population, particularly among women with first pregnancy experience and high income. Mobilizing early intervention targeted at women before pregnancy and caregiving roles might be beneficial in reducing the burden of IDA and maternal mortality and improving maternal health in LMICs.

Keyword: Iron Deficiency Anaemia, Maternal Health, Women of Reproductive Age, Pregnancy, Nigeria

Conflict of Interest Disclosure: There is no conflict of interest

PAB(T6)-15

Trends of undernourished people in South Asia: a joinpoint regression model of the sustainable development goals indicator from 2001 to 2019

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Background and objectives: Even before the COVID-19 pandemic, people experiencing hunger had been rising globally since 2014. Asia-Pacific region has housed 51% of the global undernourished people. In 2019, Southern Asia had the highest number of undernourished people (257.3 million). We aimed to track the changes and assess the possible determinants of changing the number of undernourished people in South Asia from 2001 to 2019.

Methods: We used FAO's global sustainable development goals indicators database for our trend analysis. The joinpoint regression model was applied to analyze the temporal trends. We reported a relative metric, the annual percent change (APC), of the trend for each of the South Asian countries.

Results: The number of undernourished people decreased by only 1.5% from 2001 to 2019 in South Asia. Among the countries, Nepal experienced a marked decrease (7.6% per year) in the number of undernourished people followed by Sri Lanka (4.8% per year) from 2001 to 2019. Progress was not satisfactory for India (0.1% per year) and Afghanistan (0.6% per year) whereas Bangladesh (1.4% per year) and Pakistan (1.0% per year) had a slower rate of reducing the number of undernourished people. Food price volatility in 2007-2008 might have hit hard some of the South Asian countries like Afghanistan (7.8% per year) and Bangladesh (7.1% per year) and to a lesser extent in Pakistan (2.4% per year) in raising the undernourishment. This crisis had noticeably slowed down the decreasing trend of undernourishment in India. After recovery, since 2016, the number of undernourished people had been increasing at a significant rate in all the South Asian countries mostly in Nepal (APC=10.6), Afghanistan (APC=8.8), India (APC=5.1), Pakistan (APC=3.6), and Sri Lanka (APC=2.4). This increasing trend pushed 21 million more people to undernourishment in South Asia.

Conclusions: The prevalence of undernourishment has not constantly decreased in South Asia. Nepal and Sri Lanka made good progress in reducing the number of undernourished people. However, undernourishment started to increase again in South Asia in 2016. In addition, the ongoing COVID-19 pandemic will make the goal of ending hunger more difficult to achieve in South Asia.

Keyword: Undernourishment, South Asia, Joinpoint regression model

Conflict of Interest Disclosure: The authors declare no conflict of interest

Further Collaborators: Not available

PAB(T6)-16

Usefulness of plastic bag heat-retention cooking of soft dishes for the elderly in disaster situations

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Background and Objectives: Plastic bag cooking (normal method) can be easily adapted to individual needs. The purpose of the current study was to find the best method of cooking soft foods for elderly people with reduced masticatory strength in times of disaster. Further, the normal method and plastic bag heat-retention cooking (heat-retention method) were compared for parameters, such as the hardness of cooked food and amount of gas used in cooking soft food.

Methods: To mimic conditions 4 to 7 days after a disaster, preserved foods, such as root vegetables and canned items, were used instead of fresh food. The dish used in the current experiment was "Mackerel and radish simmered in miso". Normal method: Water in a pot (1.5 L) was brought to a boil, and food ingredients in a polyethylene bag were put into the pot and heated continuously for 20, 30, 40, 50, and 70 minutes. Heat-retention method: After heating for 20 minutes as in the normal method, the pot was wrapped in a blanket and kept warm for 20, 40, 60, 80, and 120 minutes. Gas consumption was estimated by the difference in weight before and after the use of cassette gas. Food hardness was estimated in the radishes of "Mackerel and radish stewed in miso" by breaking load measurement using a creep meter (Yamaden: RE2-33005C).

Results: Normal method: after 20 minutes of cooking, the firmness of the radish was above the upper limit of the universal design food firmness (5×10^5 N/m^2), whereas after 50 minutes, the firmness was reduced to 2.3×10^5 N/m^2. Heat-retention method: After 60 minutes of heat-retention, the hardness was lower than that of the normal method after 50 minutes of heating. The amount of gas consumption to cook radishes to the same level of firmness was less in the heat retention method (36 g) than in the normal method (69 g).

Conclusion: The heat-retention method was found to be a better cooking method that could soften the food and save fuel in times of disaster.

Keyword: disaster, cooking, elderly, heat-retention, food

PAB(T6)-17
Trends in healthy lifestyles among Japanese adults from 2004 to 2015

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Background and objectives: Combined healthy lifestyle behaviors have been shown to be associated with lower mortality; however, how multiple lifestyle behaviors have trended in longevity country remains unknown. We examined the trends for combined health behaviors in the Shiga prefecture.

Methods: Design: Secondary data from the 2004, 2009 and 2015 Health and Nutrition Survey in the Shiga prefecture was used. Health behaviors score was calculated based on 5 lifestyle factors: higher diet quality, never smoked, non-excessive alcohol drinking, regular exercise, and enough sleep. The trends for the means of health behavior scores between 2004 and 2015 were examined using linear regression analysis by sex and age. Setting: Community living people. Participants: 20,126 people aged 20 years and over.

Results: In men, increased trends for health behavior scores were observed in the young (20–39 years) and older (≧ 65 years) age groups although not significantly in the middle-aged (40–64 years) group. In women, increased trends for health behavior scores were observed only in the older age group. In older women, the prevalence of regular exercise increased and the prevalence of higher diet quality decreased less compared with young- and middle-aged women between 2004 and 2015. Older women engaging in regular exercise had increased trends in diet quality, and never smoked.

Conclusions: This study revealed the increased trends in combined health behaviors among men and older women. The approach to establish an exercise habit may lead to combined multiple healthy behaviors, which could help extend life expectancy in the future.

Keyword: lifestyle, trends, diet quality, exercise, longevity

Conflict of Interest Disclosure: I have no conflicts of interest directly relevant to the content of this presentation.

PAB(T6)-18
Association between dietary patterns and visceral fat obesity in Japanese adults with normal body mass index

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Background and objectives: Dietary factors contributing to visceral fat accumulation have not been clarified in Japanese people with an abdominal circumference of ≧85 cm for men and ≧90 cm for women, although their body mass index (BMI) is normal. Therefore, this study clarified factors contributing to visceral fat accumulation from the dietary patterns of Japanese people with normal BMI.

Methods: In this study, 3,972 men and 2,929 women aged 39-74 years were included. They were participants in the Yamagata cohort with a normal BMI and completed a validated food frequency questionnaire (FFQ). Dietary patterns were extracted using cluster analysis from the intake of 19 food groups calculated from the FFQ. Further, the association between dietary patterns and visceral fat accumulation was evaluated by logistic regression analysis.

Results: The following three dietary patterns were identified for men: "rice" (n = 1,831), "side dishes" (n = 502), and "bread, noodles, coffee, and alcoholic beverages" (n = 1,639), and the three dietary patterns identified for women were as follows: "side dishes" (n = 145), "rice and bread" (n = 1,654), and "noodles and milk" (n = 1,130). The number of men with visceral fat accumulation for each dietary pattern was 418 (22.8%) for "rice", 127 (25.3%) for "side dishes", and 483 (29.5%) for "bread, noodles, coffee, and alcoholic beverages". The number of women with visceral fat accumulation that selected "side dishes" was 5 (3.4%), "rice and bread" was 68 (4.1%), and "noodles and milk" was 51 (4.5%). Logistic regression analysis adjusted for age, smoking habits, dietary energy intake, breakfasting habits, snacking habits, eating speed, and daily walk durations showed that the odds ratio of visceral fat accumulation in the "bread, noodles, coffee, and alcoholic beverages" pattern was significantly higher than that of the "rice" pattern for men. In contrast, there was no significant association between dietary patterns and visceral fat accumulation in women.

Conclusions: In men with normal BMI, dietary patterns with high consumption of bread, noodles, coffee, and alcoholic beverages may be associated with increased risk of visceral fat accumulation.

Keyword: dietary patterns, visceral fat obesity, normal BMI, men

PAB(T6)-19
A survey of the lifestyle habits of young Japanese women and an analysis of blood glucose using Continuous Glucose Monitoring (CGM)

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Purpose: According to the Japanese Ministry of Health, Labour and Welfare, the daily energy intake requirement for women in their 20s, is 1,700–2,300 kcal/day, but the National

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Health and Nutrition Survey (NHNS–J 2019) reported that it is 1,600 ± 445 kcal/day, and 20.7% have a BMI <18.5. We conducted a fact–finding survey and measured blood glucose (BS) every 15 minutes by CGM to clarify the lifestyle and nutritional intake of female students in their 20s at Kobe Women's University.

Methods: The 25 subjects, aged 21.6 ± 0.7 years old, were enrolled in a dietitian training program.Height and weight were measured and lifestyle habits investigated via a self–administered questionnaire. Energy intake was assessed using the Self–Administered Diet History Questionnaire (DHQ), and BS using the CGM (Free Style Libre Pro, Abbott) for 14 days.The range of 70 – 80 mg/dL was defined as Normal BS, >180 mg/dL as High BS, and <70 mg/dL as Low BS.

Results: The average height and weight were 158.3 ± 5.4 cm and 51.3 ± 6.3 kg, respectively.BMI was 20.5 ± 2.2 kg/m², similar to the mean values shown in the NHNS–J 2019 survey.The percentage of subjects with a BMI <18.5 was 12.0%. The questionnaire showed that the frequency of consuming a complete meal with staple, main and side dishes at least twice a day was 3 ± 2 days/week, the frequency of snacking was 5 ± 2 days/week, and 56% of the subjects consumed an evening meal at least once a week. Assessed by the DHQ, energy intake was 1,598 ± 288 kcal/day, with no significant differences in energy intake due to differences in body size or lifestyle. During the measurement period, the Normal BS, High BS, and Low BS values were 85%, 0%, and 15%, respectively, with Low BS appearing mainly during the late night and early morning hours. All of the subjects showed BS ≦ 60 mg/dL and severe hypoglycemia lasting more than 30 minutes.

Conclusion: Nocturnal hypoglycemia was observed in one healthy Japanese female subject in her 20s. The factors contributing to the appearance of hypoglycemia are under investigation.

Keyword: Lifestyle, Young Japanese women, Blood glucose, Hypoglycemia

PAB(T6)-20
Factors associated with physical inactivity among community-dwelling adults in Nigeria

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Background and objectives: Physical inactivity contributes to the magnitude of non-communicable diseases (NCDs) and is responsible for premature deaths globally. The aim of this study was to examine physical inactivity and associated factors among community-dwelling adults in Abia State, Nigeria.

Methods: A community-based cross-sectional survey was conducted among 868 adults (20 to 59 years) using multistage sampling technique. Information on sociodemographic and lifestyle characteristics was obtained using a validated questionnaire. The weight and height were measured and used to calculate the body mass index (BMI). The Global Physical Activity Questionnaire (GPAQ) was used to collect data on physical activity status. Univariate and multivariate regression were used to assess the association of physical inactivity and associated factors at a *P*-value of <0.05.

Results: The prevalence of physical inactivity was 49.8% (48.5% in males and 51.0% in females), while combined overweight and obesity was 39.4%. Older age (OR=0.49, 95% CI: 0.34- 0.71), high BMI (OR=0.67, 95% CI: 0.49- 0.91), higher income (OR=0.65, 95% CI: 0.48- 0.89), and alcohol consumption (OR=0.67, 95% CI: 0.47- 0.97) were associated with physical inactivity.

Conclusion: The high prevalence of physical inactivity among adults underscores the need for community-based physical activity interventions to reduce the burden of NCDs among adults.

Keyword: Physical inactivity, prevalence, risk factors, adults, community-dwelling

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-21
Characteristics of Cooking Class Recipes following the Great East Japan Earthquake: Analysis of Dishes, Foods, and Nutrition

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Background and objectives: The "Fureai Red Apron Project" aims to support the mental and physical health of victims of the 2011 Great East Japanese Earthquake. Since then, Ajinomoto Group, The Ajinomoto Foundation (TAF) and local partners have held 3,771 cooking classes in the Tohoku region (the Iwate, Miyagi, and Fukushima Prefecture) with 54,434 participants. In a 2020 survey, approximately 90% respondents acknowledged the importance of a balanced diet. This study aims to list the characteristics of the class recipes through menu analyses.

Methods: Recipe records from 2012–2020, from 3,588 cooking classes were analyzed. The analysis calculated the menu creator, single-dish meals, foods, nutrients, and ingredient costs.

Results: The number of menu creations was 625 by local partners and 2,963 by TAF. The percentage created by TAF was 24.9% in 2012, and more than 90% since 2016. Four hundred and three recipes out of the 1,435 single-dish meals had known ingredients and were devised by TAF, which collectively used 254 different foods 62,221 times. The details of single-dish meals are: 159 staple dishes, 367 main dishes, 122 combined dishes (staple and main dish, e.g. *sushi*), 426 vegetable dishes, 215

soups, and 146 desserts/snacks. The main protein sources were 42.1% for meat and 30.5% for seafood. Of the combined dishes 20.5% were categorized as "*sushi*," and 13.1% as "*donburi* (rice bowls)." The most frequently used foods in the main food groups were: grain: rice 2,920 times, legume: fried tofu 569 times, vegetables: ginger 1,500 times, algae: wakame 485 times, seafood: canned tuna 400 times, meat: chicken 675 times, and seasoning spices: "*mentsuyu*" (soy sauce and dashi) 2,400 times. The nutritional composition per meal was in line with the TAF target (approximately 500 kcal of energy, at least 20 g of protein, and less than 3 g of sodium). The average cost of ingredients was 276.4±24.1 yen.

Conclusion: Cooking classes in the disaster area used common, simple, economical, and safe ingredients, and considered nutrition, food culture and the living conditions of the victims.

Keyword: cooking class, menu, dish, food, post-disaster

Conflict of Interest Disclosure: Kayako Sakisaka is received research fund from The Ajinomoto Foundation in FY2020-2022. Yuka Miura is an employee of The Ajinomoto Foundation.

Further Collaborators: We sincerely thank the people of Tohoku (Iwate, Miyagi, Fukushima) for their cooperation in conducting this project.

PAB(T6)-22
Using the Ottawa Charter for Implement Healthy Eating Programs in Taiwan's Hospital

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Background and objectives: Healthy lifestyles play an important role in the prevention of premature death, chronic diseases, productivity loss, and other social and economic concerns. Diet is an important factor in preventing obesity, and chronic diseases. We want to promote workplace nutrition interventions that involved counseling, education and on-site group activities. According to the analysis of 2013-2016 Nutrition and Health Survey in Taiwan, 86% of citizens have insufficient intake of vegetables and fruits. In 2017, a survey of employees' awareness /attitudes and behaviors about healthy meals was conducted, and 98.1% agreed that healthy meals can prevent chronic diseases, but only 30.7% of people selected healthy meals at least once a day. During 2019 to 2021, the hospital planned health promotion strategy and a series of nutrition-related topics to improve the diet of hospital employees. Promote the health of workplace colleagues through continuous activities.

Methods: Use the Ottawa Charter to guide the plan. It has 4 parts: producing propaganda, holding a teaching program of healthy meals, promoting sports, providing healthy meals, "Health Expert" competition, and implementing employee health promotion projects. We set the goals:

1. Increase the proportion of healthy eating motivation by 50%

2. Willing to choose healthy meals (the number of healthy meals diners) ≧50%

3. The number of participants in the step-counting measurement has increased by >50%

Results: Nutritionists introduce the diet by using different media to publish articles, posters, and videos. We also develop teaching programs and educate colleagues of multidisciplinary team meetings and staff canteens. After the promotion in 2019, up to 99.7% are willing to follow a healthy diet. In 2020, the accuracy of Dash dietary awareness increased from the original 33.3% and 34.3% to 93.3% and 91.7%after promotion. The improvement rate reached more than 100%. The number of participants in the step-counting measurement has increased more than50%. The staff restaurant provides healthy meals and encourages employees to purchase, also holds the "Health Expert" Contest, the winner was presented by the dean every year.

Conclusions: We enhance healthy eating behaviors, promote healthy workplaces, and ensure the ability to promote clinical health through establishing a healthy eating environment.

Keyword: Workplace, Nutrition, Health promotion, Multidisciplinary team

Conflict of Interest Disclosure: none

PAB(T6)-23
Meat cooking methods and impaired glucose metabolism among Japanese

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Background and Objectives: Certain hazardous chemicals produced during high-temperature cooking of meats, including heterocyclic aromatic amine, polycyclic aromatic hydrocarbon, nitrosamines and advanced glycation end products, are suggested to be associated with increased risk of diabetes. However, few studies have examined the association between cooking method for meats and diabetes and no study has been conducted in an Asian population. Here, we examined the cross-sectional association between cooking method for meat and impaired glucose metabolism. We hypothesized that the prevalence of impaired glucose metabolism would be high among participants who most frequently cook meat by deep-frying.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: Participants were 1832 men and women (aged 18-69 years) with no history of serious disease. Participants were asked to select the most frequently used cooking method for meat from 5 options (raw, stewing, broiling, deep-frying, and stir-frying). Multiple logistic regression analysis was used to estimate the odds ratios of impaired glucose metabolism (history of diabetes, current use of anti-diabetic drugs, fasting blood glucose ≧110 mg/dl, or HbA1c ≧6.0%) for each cooking method.

Results : The number of participants by the most frequently used cooking method for meat was 2 (0.1%) for raw, 68 (3.7%) for stewing, 1253 (68.5%) for broiling, 66 (3.6%) for deep-frying, and 443 (24.2%) for stir-frying. Participants who indicated raw as the most frequent cooking method were excluded from the present analysis due to their small number. Of the remaining 1830 participants, 203 participants (11.1%) were identified as having impaired glucose metabolism. Cooking method for meat was not significantly associated with impaired glucose metabolism: compared with broiling, multivariable-adjusted odds ratios (95% confidence interval) were 1.20 (0.54-2.66) for stewing, 1.19 (0.50-2.87) for deep-frying, and 0.73 (0.49-1.10) for stir-frying.

Conclusions : Contrary to our hypothesis, deep-frying as a cooking method for meat was not associated with the prevalence of impaired glucose metabolism.

Keyword: cooking method, meat, Japanese, impaired glucose metabolism, type 2 diabetes

PAB(T6)-24
The effectiveness of lifestyle interventions on the prevention of type 2 diabetes: A systematic review and meta-analysis of evidence from low- and middle-income countries

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Background and objectives: T2D is largely preventable by adhering to an optimal lifestyle as suggested by an extensive body of evidence conducted in HICs. However, its generalisability to settings with constraint resources remains uncertain. This study aims to evaluate the effectiveness of lifestyle interventions on the prevention of T2D in LMICs.

Methods: A systematic review and meta-analysis was conducted in MEDLINE, Embase, Web of Science, and Cochrane Library for studies published in English, Spanish, French, and Portuguese between 1 January 2000 and 23 June 2021. The eligibility criteria included RCTs evaluating multi-component and multi-target lifestyle interventions in high-risk populations living in LMICs. The Cochrane risk-of-bias tool for randomised trials was used to assess the risk of bias. The main outcomes were the incidence of T2D and indicators of glycaemic control. Inverse-variance random-effects meta-analyses calculated the overall effect sizes and 95% CI. Heterogeneity was measured by Cochran's Q and I^2 statistics and explored using multivariate meta-regressions. Funnel plots and Egger's test were used for publication bias assessment. If present, trim-and-fill adjusted pooled effect sizes were estimated.

Results: From 11,885 abstracts identified, 43 interventions met the eligibility criteria of which 81.4% were conducted in Asia, 16.3% in America, and 2.3% in Africa. 32.6% of the studies were considered at low risk of bias, 55.8% were ranked as moderate risk, and 11.6% as high risk. The interventions had a median of 260 (IQR: 142 to 507) participants and a median duration of 6 (IQR: 3 to 12) months. Study-specific estimates per outcome ranged between 31 - 7estimates. Overall, lifestyle interventions considerably decreased the incidence risk ratio of T2D by 28% (0.72, 95% CI: 0.58 to 0.90), and reduced the levels of HbA1c by 0.17% (-0.30 to -0.05), and 2-hr glucose tolerance by 4.98 mg/dL (-8.40 to -1.56). After adjusting for publication bias, no effect was found for FPG. Substantial, and unexplained, levels of heterogeneity were observed for all outcomes (I^2≧ 82.0%).

Conclusions: The results of this study support the use of comprehensive lifestyle interventions as an important public health strategy for the prevention of T2D, among high-risk populations in LMIC.

Keyword: Type 2 diabetes, Prevention, Lifestyle modification, Low- and middle income countries

Conflict of Interest Disclosure: None.

Further Collaborators: None

PAB(T6)-25
Effects of parental psychological factors on the anthropometric characteristics of children with intellectual disabilities

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Background and objectives: A higher frequency of overweight in children with intellectual disabilities is well known[1,2]. Their environment, such astheir parents' attitude towards health matters, may affect this issue, however, this link has not yet been well established. The aim of study was to examine how parental psychological factors, such as self-efficacy and outcome expectancy, affect the anthropometric characteristics of children with intellectual disabilities.

Methods: We conducted a cross sectional study involving sixteen schools for special needs education in Ibaraki prefecture, Japan. A questionnaire regarding the parents' self-efficacy, outcome expectancy and a brief self-administered diet history questionnaire (BDHQ) was distributed to parents of all school children in first grade to sixth grade of elementary department aged 6 yr to 13 yr at the beginning of September. We analysed

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

children who were completely answered these questionnaires. The exposure variable was the anthropometric characteristics such as lean, normal, overweight, assessed using the height and weight measurements self-reported on the BDHQ. The parents' self-efficacy and outcome expectancy were assessed using a five-ordinal scale. We used logistic regression analysis to estimate odds ratio with 95% confidence interval for analysis of effects of these parental factors on the anthropometric characteristics of children with intellectual disabilities.

Results: We observed an association between parental psychological factors and the anthropometric characteristics of the children with intellectual disabilities.

Conclusions: Support, such as a school-based nutrition education program, may be required to develop parental attitude influencing the eating behaviour of children with intellectual disabilities. The use of these types of programmes might be required for the healthy development of mind and body, which could be one of the factors which determine their future quality of life.

1.Segal, Mary, et al. "Intellectual disability is associated with increased risk for obesity in a nationally representative sample of US children." *Disability and health journal* 9.3 (2016): 392-398.

2.McGillivray, J., et al. "Parental factors associated with obesity in children with disability: a systematic review." *Obesity Reviews* 14.7 (2013): 541-554.

Keyword: anthropometric characteristics , children with intellectual disabilities, self efficacy , outcome expectancy

Conflict of Interest Disclosure: This work was supported by JSPS KAKENHI Grant Number 21K20194

PAB(T6)-26
Chronic non-communicable diseases in relation to healthy habits and behaviors in employees of an educational institution

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Background and objectives: Health is a fundamental right of all people, without distinction of religion, race, economic, social, or religious status. To achieve this, responsible and cooperative work by everyone, and from public and private entities and states, is essential. Considering that chronic non-communicable diseases are the leading cause of death worldwide, but can be controlled, and above all, preventable, and that lifestyle habits also have an impact on it, our objective was to identify healthy habits and behaviors in relation to chronic non-communicable diseases in the collaborators of an educational group. **Methods**: As part of the 2021 annual medical-occupational evaluation in San Ignacio de Loyola Corporation, clinical exams were carried out and a digital survey called “Healthy Habits and Behaviors” was applied to 610 employees between 23 and 70 years old. The descriptive analysis was expressed in proportions. **Results**: The evaluated population presents a regular sleep between 6 and 8 hours (85.08%), as recommended by the WHO, most of those who sleep between 6 to 7 hours (29.34%) and more than 8 hours (1.64%), perform physical activity for at least the recommended time. 62.62% indicate that they do not present any of the diseases consulted (heart disease, hypothyroidism, hypertension, excess weight). 48.36% perform physical activity for 30 consecutive minutes at least three times a week, while 51.64% indicate that they do not. Unlike people with heart disease, hypothyroidism or hypertension, the majority of people with obesity (3.11%) do not perform the minimum amount of physical activity recommended. Most of those with high blood pressure (3.44%) and overweight (16.39%) indicate that stress or anxiety negatively affects their diet. **Conclusions** It is extremely important to know the prevalence of knowing the prevalence of cardiometabolic risk factors to join efforts, addressing the improvement in the form and quality of life from public policies to responsible individual care. Given this, companies and workspaces become relevant with the actions they carry out to promote and raise awareness of health.

Keyword: Mortality, chronic non-communicable disease, healthy habits, occupational health

PAB(T6)-27
Understanding supports for and barriers to school food environment and childhood obesity prevention in Thailand: a qualitative study

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Background and objective: The prevalence of childhood overweight and obesity has increased dramatically due to the school food environment. However, information on the factors linked between school food environment and childhood obesity is scarce in Thailand. This study aimed to investigate supports for and barriers to a healthy school food environment concerning obesity in school-age children.

Methods: This study was conducted at public and private primary schools in the central region of Thailand. Data were collected from sixteen in-depth interviews with school staff and 18 focus group discussions with 9 to 12 years old students. Code transcripts from the interviews were analyzed manually. Hurricane analysis was used to illustrate the relationship among variables from data analysis and gain a new perspective on those data. Concept mapping was used to depict the relationship of supports and barriers to improving the school food environment.

Results: This study found four main themes: food access, facilities, knowledge support, and school food/health policies related to childhood obesity prevention and school food

environment. Participants realized that nutrition knowledge was crucial for preventing less healthy food access to students. The current nutrition training program for school staff was needed to improve. In addition, a much more specific practice on the quality of school lunch management was required.

Conclusions: The findings point to numerous inter-and intra-relationships of support for and barriers to factors responsible for preventing childhood obesity and improving the school food environment. Understanding the risk factors in which the food environments affect childhood obesity is a crucial component to designing interventions that increase the availability of healthy and affordable foods, thus improving the health of semi-urban school communities. It is anticipated that policymakers will consider the national application of this approach for food and nutrition planning and preventing non-communicable diseases for children.

Keyword: Thailand, School food environment, Childhood obesity, Hurricane diagram, Concept mapping

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PAB(T6)-28
Understanding mothers perceptions regarding the weight of their preschool children with overweight and normal weight , Lima

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Backgrounds and objectives: The prevalence of obesity in children under five years old has increased and it's important that mothers recognize that their child has a problem with his weight. Objectives: To understand mothers' perception of their normal or overweight children's weight from low socio-economic status in Lima, Peru.

Methods: Qualitative in-depth semi-structured interviews were conducted with 16 mothers of eight preschool children who were overweight and eight with normal weight who attended at the health facility of Lima, Peru. Interview was transcribed verbatim by hand and used thematic analysis.

Results: Two main themes were identified: 1) Interpretation of weight: most of the mothers of overweight children had a mistaken perception, indicating that their child had an adequate weight. There were also mothers with normal children's weight who expressed concern because they perceived that their child was underweight. Mothers who did not perceive excess weight in their child believed that they gave a healthy diet to their children. Those who perceived the existence of excess weight expressed two different reasons: first, the excess was due to the consumption of energy-dense foods and second, they were self-blaming for inadequate feeding practices with their child. 2) Prevention of excess weight: all the mothers considered that their children's weight should be monitored to keep them healthy and ensure adequate growth. Mothers with overweight children who see them at an adequate weight were aware that excess weight was a condition for chronic diseases.

Conclusions: The findings suggest that maternal perception of the child's weight was connected to their interpretations of their child's weight and daily dietary practices. Mothers with normal-weight children saw them as thin, while mothers with overweight children perceived them to be underweight or overweight. However, there were mothers who were aware of the fact that excess weight leads to chronic diseases and that it was important to feed them healthy for adequate growth.

Keyword: Preschool, Mothers, Perception, Overweight, Qualitative research

Conflict of Interest Disclosure: No conflict of interest

PAB(T6)-29
Global association between Traditional Japanese diet score and hypertension prevalence: a cross-sectional and longitudinal ecological study

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Background and objectives: Traditional Japanese diet is thought to contribute to the healthy longevity of Japanese people. We established the Traditional Japanese Diet Score (TJDS) using common foods and reported through ecological studies that the TJDS has associated with longer healthy life expectancy and lower incidence and mortality of several non–communicable diseases worldwide. On the other hand, the traditional Japanese diet is high in salt, which is thought to be one of the causes of elevated blood pressure and hypertension. The purpose of this cross–sectional and longitudinal ecological study is to clarify the global association between TJDS and hypertension prevalence.

Methods: Average food supply (g/day/capita) by country were obtained from the Food and Agriculture Organization of the United Nations database. TJDS by country was calculated from eight food groups and the total score ranged from –8 to 8, with higher scores indicating greater adherence to a traditional Japanese diet. Hypertension prevalence by country was obtained from NCD Risk Factor Collaboration. As covariates, we used GDP per capita, aging rate, years of education, smoking rate, physical activity, average BMI, energy supply, and sodium intake obtained from the World Bank database and other sources. We evaluated the cross-sectional and 10–year longitudinal association between TJDS and hypertension

prevalence using 2009 as the baseline in 140 countries with populations of more than one million.

Results: In cross–sectional analysis, in model 1 without controlling for covariates, model 2 controlled for GDP, and model 3 controlled for all covariates, TJDS was negatively associated with hypertension prevalence (β ± standard error; –0.010 ± 0.002, p<0.001; –0.011 ± 0.002, p<0.001; –0.007 ± 0.002, p<0.001; respectively). In 10–year longitudinal analysis, in model 1 without controlling for covariates, model 2 controlled for GDP, and model 3 controlled for all covariates, TJDS was negatively associated with hypertension prevalence (–0.010 ± 0.002, p<0.001; –0.011 ± 0.002, p<0.001; –0.007 ± 0.002, p<0.001; respectively).

Conclusions: This cross–sectional and longitudinal ecological study suggests that the traditional Japanese dietary pattern have associated with suppressed the prevalence of hypertension in the following 10 years on global scale.

Keyword: Traditional Japanese diet score, Hypertension prevalence, Ecological study, Longitudinal analysis, FAOSTAT

Conflict of Interest Disclosure: No

PAB(T6)-30
An online-based, supportive group nutrition coaching program as a tool for weight loss during COVID-19: a single-arm trial

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Background and objectives: The global prevalence of obesity is worsened with the emergence of COVID-19, including in Indonesia. Obesity, on the other hand, is also a risk factor for severe COVID-19 outcomes. Several consequences are attributable to the implementation of physical distancing, such as limited access to healthcare and healthy food, sedentary lifestyle, and stress that may lead to weight gain. Therefore, there is a need to get past the geographical barrier in the effort of overcoming obesity. This study aimed to evaluate the effect of an online-based, supportive group Nutrition Coaching Program (NCP) on weight loss during COVID-19.

Methods: This study involved 61 participants across Indonesia (female: 91.8%) between August and September 2021. Participants were recruited from social media (Instagram) based on their interest in joining 30-day NCP. Prior to joining the program, participants self-reported their age, height, and weight to determine BMR for creating a 30-day meal plan, and they re-weighed themselves after completing the program. They were instructed to consistently measure their weight on an empty stomach in the morning. Participants were added to a WhatsApp group to receive the meal plan during the program, which they could modify using the Indonesian exchange food list table (DBMP). The meal plan consisted of a 10-day menu rotation containing food ingredients, weights, and recipe samples. They were also given exercise guidelines, weekly thematic nutrition education, daily supportive reminder, and question-and-answer sessions by registered nutritionists and a sports scientist. Paired t-test was used to analyze weight changes before and after the program.

Results: The participants' baseline characteristics were (mean±SD): age 33±5 years, height 158.3±7.2 cm, weight 71.6±12.9 kg, BMI 28.5±4.5 kg/m^2, and BMR 1311.6±161.6 kcals. Weight measurements before and after the program were 71.6±12.9 kg and 68.4±11.9 kg, respectively (p<0.001). Furthermore, the weight loss was 3.1±3.0 kg during 30 days which is considered within the healthy rate for weight loss (0.5-1 kg/week or 2-4 kg/month).

Conclusion: Online-based, supportive group NCP may potentially help weight loss during COVID-19. Further investigation is needed to obtain more robust data on the effectiveness of an online-based nutrition education program in combating obesity.

Keyword: Obesity, Overweight, Weight loss, Nutrition education, COVID-19

PAB(T6)-31
Relationship between green tea intake and human gut microbiota on glucose metabolism: a four-season nutritional survey

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Background and objectives: Little is known about the extent to which depends on the association between green tea intake and human gut microbiota (HGM) on glucose metabolism. This study aims to examine the biological process related to glucose metabolism by modifying the human gut microbiota HGM via green tea intake, considering seasonal variations.

Methods: At each season, 89 non-diabetic participants supplied blood and faecal samples, 3-day weighed dietary records. The relative abundance of HGM was profiled using a next-generation sequencing approach. Biomarkers of glucose metabolism such as fasting blood glucose, haemoglobin A1c and insulin were measured. The respective associations among green tea and catechins intake, the HGM and the biomarkers of glucose metabolism were analysed using linear mixed-effect model with multiple imputation for missing values. We used a false discovery rate p-value to adjust for multiple comparisons with a threshold of < 0.20. Mediation analysis was performed to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

determine whether the HGM can explain the effect of green tea intake on glucose metabolism.

Results: Green tea intake was negatively associated with fasting blood glucose and insulin ($p < 0.05$), marginally lower in autumn than in winter. Green tea intake was not related to any HGM, while the relative abundance of Actinobacteria and *Bifidobacterium* were associated with lower insulin and HOMA-IR (false discovery rate $p < 0.20$). The mediation effect of HGM was not found.

Conclusions: In non-diabetic participants, we demonstrated that habitual consumption of green tea, and two types of bacteria separately modulate insulin secretion to improve glucose metabolism, which was influenced by the season.

Keyword: Human gut microbiota, Glucose metabolism, Green tea, Mediation analysis, Nutritional epidemiology

PAB(T6)-32
Basic research on a proposing nutrient profile model for Japan

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Objectives: A nutrient profile model ranks foods according to their nutritional composition, which allows individuals to make well-informed dietary choice. No nutrient profile model has yet been developed in Japan while such models are likely to be context specific. Therefore, this study aimed to propose a nutrient profile model applicable to the Japanese population.

Methods: We proposed a Japanese nutrient profile model for processed foods based on the protocol of World Health Organization (WHO) 2010 technical meeting report, WHO guiding principles and framework manual for front-of-pack labeling for promoting healthy diets in 2019, and several models used in other countries. The data from the Japanese National Health and Nutrition Survey (NHNS), Dietary Reference Intakes for Japanese (2020), Standard Tables of Food Composition in Japan 2015 (7th revised edition), and Nikkei-POS database were used as the reference data.

Results: Considering the nutrition status of Japanese population, we proposed the model to target those aged 18 years or older. A category-specific (threshold setting) model was adopted with setting thresholds to avoid overconsumption of total fat (≧30% of total energy), saturated fat (≧7% of total energy), sodium (1.25 ≧ mg/kcal) or salt equivalent (≧ 3g/650kcal meal), and energy (category specific) for processed foods and prepared foods. Processed foods were classified into 15 categories based on the Japanese NHNS. Seasonings such as soy sauce and miso, and oils were separately considered as a part of nutrient profile of dishes. We set the nutrient criteria for the proposed model and determined thresholds for each food category. When the thresholds of each food category were compared with those set in the models of other countries, no substantial difference was observed. However, more than half of food items exceeded the thresholds for salt equivalent in some categories, namely bread, dry noodles, pickles, fish, meat and egg products, and some of prepared foods.

Conclusions: The present nutrient profile model was proposed to meet the Japanese context in terms of public health nutrition status. Further consideration on the applicability is needed to improve this model in line with the practical status in Japan.

Keyword: nutrient profile models, processed foods, prepared foods, food category , threshold value

Conflict of Interest Disclosure: The authors declare that they have no conflicts of interest.

PAB(T6)-33
Relationship between maternal socioeconomic status and infant children's sleep and breakfast habits

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Background and objectives: In Japan in recent years, there is concern that differences in regional and socioeconomic environments are causing significant health disparities. Parents' education level and socioeconomic status (SES) has an effect on children's sleep habits, and can lead to disparity in infants' lifestyle habits. This study investigated the relationship between maternal SES and their infant children's breakfast and sleep habits, as well as their lifestyle rhythm.

Methods: An online survey was conducted in June 2019, targeting mothers aged 20-49 with children aged 3-5. The questionnaire surveyed the mother and children's breakfast habits, sleep habits, circadian typology (CT), household income for the previous year, and the mother's level of education. 1,529 responses (average age 36.2 ± 5.0 years), were targeted for analysis. Responders were divided into two groups: the first included mothers with a high school education and below (23.8%) and those with a junior college education and above (76.2%); the second group included mothers with an annual household income of less than 4 million yen (24.3%) and those with an annual household income of 4 million yen or more (75.7%). Results were examined using the X2 test, Mann-Whitney U test, using logistic regression analysis (variable increase method).

Results: Children of higher-educated mothers were more likely to consume breakfast daily at a regular time. Children also slept earlier ($p=0.003$) and woke up earlier ($p<0.001$), but no difference was observed in sleep duration. CT was morning-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

typed (p<0.001). Children in higher-income households had consistent breakfast habits and early waking times on weekdays (p=0.048), with a morning-typed CT (p=0.020). A logistic regression analysis based on whether or not the child is evening-typed (score of 7-13) as the dependent variable determined an association with parents' CT and regularity of children's breakfast habits, but not with higher income and education.

Conclusions: Although mothers and children with higher SES (particularly higher-educated mothers) generally had better sleep and lifestyle habits, as well as higher breakfast regularity, there was no direct relationship observed between SES and children becoming evening-typed, suggesting that low SES is not necessarily associated with children becoming evening-typed.

Keyword: Socioeconomic status, Circadian typology, Breakfast habits, Sleep habits

PAB(T6)-34
The Evolution of Thai Dietary Assessment Software: INMUCAL-Nutrients

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Background and objectives: Nutritionist researchers have unique computational softwares to calculate nutrients. Institute of Nutrition, Mahidol University (INMU) has been developing the INMUCAL-Nutrients (INMUCAL) software from DOS version since 1980s for Thai and Asian nutritionists and all needed. The INMUCAL is quite unique software that contained Thai and Asian food database from various sources. The objective of this study was to describe process development of the INMUCAL software for Windows version.

Methods: The INMUCAL consisted on 4 main databases; Thai food composition databases (Thai-FCDB), edible-inedible food database in gram, conversion factors from cook to raw, and household unit converting in gram. The data structure was developed and prepared based on FAO/INFOODS Guidelines by INMU-DatabasesCompiler (iDC) software. The both software are run on Windows based software, which were developed by Pascal programming language on Delphi software. MySQL sever were used to store the FCDB.

Results: The iDC was able to compile, store information and edit data. FCDB is a uniquely accurate and compliant databases containing over 3,500 food items and recipes. The number data of edible-inedible foods, household unit converting, conversion factors from cook to raw and oil absorption factors were 483, 14,899, 2,225 and 657 data, respectively. The INMUCAL was able to generate 35 nutritive vales as default comparing to the nutrient reference. It also can export food groups and food items comparing to food guidelines. The outputs were exported to Microsoft Excel format for further statistical calculation. The INMUCAL has been also provided the online training for the new users and online supported.

Conclusions: The INMUCAL for Windows version is the user friendly. It can reduce human errors. The software has the potential to increase the accuracy and efficiency in diet design and provide standardization among researchers conducting similar studies. The INMUCAL is an example of how researchers and industry can work together and develop products that not only has research benefits, but also generates follow-on research and additional commercial products and opportunities for the developer. Ultimately, the INMUCAL and associated products will result in company and employment growth while providing for government computing needs.

Keyword: dietary assessment, food composition database, nutrient, software, database

PAB(T6)-35
Estimating the future burden of type 2 diabetes in Belgium: a modelling study

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Objective: To estimate the burden [the incidence, prevalence and mortality] of type 2 diabetes [T2D] in Belgium over ten years [2018-2028] **Methods**: A microsimulation model [MSM] was developed and implemented as a discrete-event state transition model with two events T2D and death, updated annually. Information from a representative [age, sex, and province] sample of the Belgian adult population [18-80 years] provided by the latest [2018] Belgian Health Interview Survey and complemented with estimates on the prevalence of cardiometabolic risk factors from the latest [2018] Belgian Health Examination Survey was used to recreate a Belgian synthetic population using the R package SimPop after Multiple Imputation by Chained Equations. Starting annually since 2018, individuals in the MSM transition from health to death, with or without developing T2D, were estimated using the Finnish Diabetes Risk Score's concise model with prevalent risk factors [e.g. hypertension, BMI] updated via age-sex-specific transition probabilities. Mortality rates for Belgium were retrieved from the Standardized Procedures for Mortality Analysis database and used to calculate the death probabilities used through the MSM. **Results**: A total of 3275 [95%UI: 3263, 3287] incident cases T2D per 100,000 inhabitants are expected between 2018 and 2028 in Belgium, with higher rates among older individuals. A modest gender-related gap in T2D incidence, unfavorable to females, is foreseen to increase over the course of 10 years. A total of 393 [387, 400]/100,000 new cases among females compared to 378 [371, 384]/100,000 in males are estimated for 2028. Prevalent T2D is expected to increase by 2028 for both females [+16.4%] and males [+12.6%] from 2018 levels (5419 [5387, 5442]/100,000, and 5627 [5605, 5650]/100,000 respectively). Mortality rates attributed to T2D are expected to remain relatively low (119 [117, 122]/100,0000) and stable up to 2028. A slight decrease in mortality rates among the 65+ years

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

old is expected. **Conclusion**: The burden of T2D in Belgium is expected to remain high over the next years. Preventive strategies should be strengthened to delay the onset of new T2D cases and decrease the burden.

Keyword: Type 2 diabetes, Burden, Microsimulation model

PAB(T6)-36
Assessing food environments in low- and middle-income countries—unlocking the potential to improve diets, nutrition, and health outcomes

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Background and objectives: Poor diets are a major contributor to the global burden of disease. Various food system factors shape diets, especially through food environments where food and consumers meet. Globally, foods are increasingly procured from markets. Understanding market food environments is critical to influence food choices toward safe, nutritious diets. However, few assessments are suitable for use in diverse LMIC contexts. USAID Advancing Nutrition is helping identify suitable assessments to support practitioners to implement market food environment assessments and to use resulting data to influence food environments toward safe, nutritious diets.

Methods: Through literature review and expert survey, USAID Advancing Nutrition identified a set of seven existing food environment assessments for adaptation and testing in diverse LMICs. Through market vendor interviews and focus group discussions, we are gathering primary data on key dimensions of market-based food environments, such as accessibility, availability, affordability, and desirability of foods, and qualitative data on implementers' experiences conducting assessments. USAID Advancing Nutrition is analyzing the data to understand if the assessments are suitable for capturing food environment data that supports programmatic actions, and if modifications can facilitate implementing the assessments in LMICs.

Results: This ongoing pilot study will test market-based assessments in multiple LMICs. In Liberia, we found that modifying existing assessments enhanced their suitability for use in markets to collect data on vendor characteristics, diverse food availability, and costs of nutritious foods. We found that a more complex assessment may not be suitable across contexts, and can be replaced with a simpler validated assessment to gather data on nutritious food availability. Through qualitative assessment of implementation experiences, we identified additional modifications that will further support assessment suitability in LMICs.

Conclusions: Results from this study will enhance market food environment data collection across LMICs by providing evidence-based tools suitable for use in diverse contexts. Results will enable a more comprehensive understanding of market food environments in LMICs to support food systems approaches that improve the affordability, availability, and desirability of safe, nutritious food. Equipped with suitable assessments, practitioners will be empowered to unlock the potential for food environments to improve diets, nutrition, and health.

Keyword: Food environments, Diets, Food systems, LMIC

PAB(T6)-37
Different types of fats but not total fat intake are associated with cardiometabolic risk factors in adults of a population-based study in Brazil

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Background and objectives: Emerging evidence has suggested that fats would have complex health effects, and their role in the etiology of cardiometabolic diseases is not fully elucidated. Thus, this study aimed to evaluate dietary fat adequacy and explore the relation between cardiometabolic risk factors and dietary intake of different types of fats among São Paulo residents.

Methods: Data came from the Health Survey of São Paulo, a cross-sectional population-based study including 603 individuals aged 20+ years representative of the population of São Paulo, Brazil. Dietary intake of total fat, saturated fat, MUFA, and PUFA was assessed by 24-hour recalls, and adequacy was evaluated according to the Brazilian Society of Cardiology, which is based on the markers of dyslipidemia. Cardiometabolic risk factors included: total cholesterol, HDL-c, LDL-c, triglycerides, waist circumference, fasting plasma glucose, and body mass index (BMI). Associations between risk factors and dietary fats adequacy (the proportion of individuals meeting the recommendations) were evaluated by logistic regression models. The association between the percentage of energy intake from each type of fat and cardiometabolic risk factors was assessed by generalized linear models. All models were adjusted by age, sex, and energy intake.

Results: Adequacy of total fat intake was 72%. On the other hand, 96.8% of the population had a consumption of saturated fat above the recommendations, while most of the population did not ingest enough MUFA and PUFA (91.5% and 97.4%, respectively). Individuals with a saturated fat intake above recommended levels had higher *odds* of having a waist circumference indicative of very high cardiometabolic risk (OR=2.96; p=0.044). The intake of saturated fats was positively associated with waist circumference (p=0.007) and BMI (p=0.01). No significant results were found for total fat intake.
Conclusions: There was excessive consumption of saturated fat and an insufficient intake of MUFA and PUFA among São Paulo adults. This inadequate intake was associated with cardiometabolic risk factors, especially related to saturated fat. Rather than recommending the reduction of total fat intake, policies should emphasize the consumption of MUFA and PUFA to the detriment of saturated fat as a strategy to prevent cardiometabolic issues.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Fat intake, Cardiometabolic factors, Dietary assessment, Nutrition survey

Conflict of Interest Disclosure: None.

Further Collaborators: Funding: This work was supported by the São Paulo Research Foundation (grant numbers 2020/019451-9 and 2014/26787-0).

PAB(T6)-38
Food handling practices, nutrition knowledge and attitude of staff at Early Childhood Development centers in the Western Cape Metropole, South Africa.

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Background: Early childhood development centres (ECDCs) provide a potential environment where children can develop healthy eating behaviors. A well-planned menu, prepared in a safe and nutritious way can meet up to a third of a young child's daily dietary needs whilst in a day-care facility. Guidelines for the provision of food in ECDCs in South Africa (SA) exist but data on the implementation is required. Objectives were to evaluate the food preparation environment, staff food handling practices and nutrition knowledge and attitudes of staff in promoting healthy eating.**Methods**: A cross-sectional, descriptive study was conducted. An observational audit was completed at 46 randomly selected ECDCs. For inclusion, ECDCs had to be in operation for at least 6 months, cater for children 0-5 years and serving at least a meal and a snack per day (for children >6 months). Census sampling of ECD staff was done. Staff (N=162) completed a self-administered questionnaire. **Results**: Mean overall score for the observational audit was 50% (SD 11.78). Highest scores were obtained for personal hygiene (86.5%; SD 11.17), although regular handwashing was not observed (34.7%). Dry store storage scored 72.6%. Food handling practices had a mean score of 48.8%. Cleaning of work surfaces were insufficient (54.7%). Only 23.9% had a separate meal area. Staff sat with children during mealtimes (84.7%) and enough cutlery and crockery was available at 44 ECDCs (95.6%). Mean nutrition knowledge of ECD staff were 69.9% (SD 10.15). Lowest scores related to calcium-rich foods (17.3%) incorrect practice of replacement of fruit with fruit juice (38.2%), safe meat defrosting (30.8%) and safe storage of meat products (27.7%). The majority of staff (68%) disagreed with the statement: “It is only the parents' responsibility to ensure children eat healthy”. A statistically significant association was found between higher staff education level and disagreeing with this statement (p=0.042).**Conclusion**: There is substantial opportunity for improvement in the food environment at ECDCs in the Western Cape Province, SA. Regular monitoring should be a priority to ensure implementation and adherence to food provision guidelines with the aim of protecting and promoting the health of children attending ECDCs.

Keyword: nutrition, childhood, food handling practices, knowledge, Early childhood development centres

Conflict of Interest Disclosure: N/a

Further Collaborators: N/a

PAB(T6)-39
Correlation between Consumers' Inclination towards Healthy, Sustainable Food and Willingness to Pay: Analysis from the Standpoint of Socioeconomic Background, State of Food Intake, and Food Environments

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Background and objectives: As the media has great influence on daily food sales, consumers' food choice behavior is not necessarily rational. This is because individuals tend to prioritize immediate gains over long-term ones. In order to explore strategies to encourage rational behavior, this study examines the correlation between the inclination to buy healthy, sustainable food and willingness to pay (WTP) and the factors related to WTP.

Methods: An online survey among females aged 20 to 49 was outsourced to a private research firm. Survey items were: basic attributes, socioeconomic status (SES), eating habits, stores they frequently use, social capital (SC) index, and food insecurity (FI) index. A total of 1,110 responses were obtained, and the participants who do not shop and those with insufficient responses were excluded, which left 850 subjects to be analyzed. The Chi-square test was used to examine the correlation between consumers' inclination and WTP, and the logistic regression analysis was used for the factors related to WTP.

Results: The subjects inclined to buy food that leads to healthy meals (22.4%, “healthy group”) and those inclined to buy sustainable food (14.2%, “sustainable group”) showed their willingness to purchase despite the price. However, 30% of the subjects who responded “I would buy” did not show willingness after the price was shown. In the healthy group, the factors related to their willingness to buy were age, income, and educational background. As for the factors related to adjusted SES index and willingness, the subjects in the healthy group eat soy products at least once a day and the subjects in the sustainable group eat soy products and green and yellow

vegetables at least once a day. Furthermore, the healthy group was more actively involved in their local community.

Conclusion: Although there was a correlation between inclination and WTP, the gap between the two was also confirmed. In order to achieve consumers' rational behavior, it is necessary to create food environments that prompt people to choose healthy and sustainable food and to encourage them to change their behavior.

Keyword: inclination to buy, willingness to buy, healthy meal, sustainable food, food intake

Conflict of Interest Disclosure: The authors declare no conflicts of interest associated with this manuscript.

Further Collaborators: No collaborators

PAB(T6)-40
Increase in ultra-processed food consumption and micronutrient inadequacy in Indian population

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Background and Objectives: Increased consumption of ultra-processed foods which are high in energy, fat, sugar and salt and low in micronutrients raises many public health challenges. This study assessed the consumption of ultra-processed foods and explored its impact on macronutrient intake and risk of micronutrient inadequacy.

Methods: A cross-sectional study design with non-probability purposive sampling followed by snowball sampling was used to collect dietary data from 589 adults (20-40 years) in Delhi, India. Nutrient intake was assessed using 24-hour dietary recall method on two non-consecutive days. Statistical software R (version 4.1.1) was used to analyse data. Mann- Whitney U test was used to assess difference in probability of nutrient inadequacy between males and females. The association between energy contributed by ultra-processed food and risk of micronutrient inadequacy was calculated by spearman's rank correlation. The p-value <0.05 was considered as statistically significant.

Results: The contribution to energy intake by fat, protein and carbohydrate was 33%, 9.5% and 56% respectively. Ultra-processed foods contributed to 17% of total energy intake, 12 % of protein, 17% of carbohydrate, 29% of added sugar, 20% of total fat and 33% of sodium intake. The nutrient contribution from ultra-processed food intake was significantly higher among males than females for energy (17.7% vs 16.7%), total fat (22% vs 19.2%) and free sugar (32.7% vs 24.1%). The average risk of nutrient inadequacy was above 90% for calcium, zinc, riboflavin, vitamin B6, vitamin B12, vitamin D and males had a higher risk of inadequacy ($p<0.001$). The average risk of niacin inadequacy among males was 83% and 44% among females ($p<0.001$). The average risk of iron inadequacy among males was 6.5% and 58% among females ($p<0.001$). The average risk of vitamin A inadequacy among males was 44% and 68% among females ($p<0.001$). There was positive correlation between energy contributed by ultra-processed food and the risk of niacin ($\rho=0.136$, $p=0.001$) and folate ($\rho=0.089$, $p=0.049$) inadequacy.

Conclusions: Reformulation of ultra-processed food to reduce fat, sugar and salt, behaviour change communication strategies to encourage healthier food choices and promotion of dietary diversity will help improve micronutrient adequacy and quality of diets.

Keyword: Diet quality, Nutrient adequacy , Healthy food choices , Public health

Conflict of Interest Disclosure: None, the authors report no conflict of interest

Further Collaborators: None

PAB(T6)-41
Association between dietary behavior and psychological impact on university students during the state of emergency in Kochi, Japan

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Background and objectives: The negative psychological impacts induced by stressful events alter dietary habits and eating patterns. To prevent the spread of SARS-CoV-2, many countries employed various measures such as restrictions on movement of people. Such restrictions might induce psychological distress. The restrictions were also implemented in Japan, but these were much less restrictive than the lockdown introduced in other countries. In addition, the number of infection cases varies between small regional towns and the major cities in Japan. The purpose of this study was to access the psychological distress and changes in dietary habits under the restrictive measures implemented in a small regional city in Japan with low number of infections.

Methods: A questionnaire-based cross-sectional survey was conducted on university students (N = 356) in the Kochi prefecture of Japan. We asked participants about their lifestyle and dietary habits during the restrictive measures. We also assessed their psychological distress levels using a distress index. To evaluate the association between psychological distress and dietary habits, we performed statistical analyses using a multiple logistic regression analysis.

Results: The prevalence of moderate and severe psychological distress was in 17% of the population. Furthermore, 38% of participants exhibited irregular eating habits. Participants who had irregular eating habits increased consumption of snacks and the ready-to-eat meals. We found that psychological distress levels were higher in participants who

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

had irregular eating habits compared to those with normal eating habits. A multiple logistic regression analysis for checking the prevalence of irregular eating habits revealed the extent of participants' psychological distress score (odds ratio [OR]: 1.07, 95% confidential interval [CI]: 1.04-1.10, for every one point increase) and human-to-human contact (OR for normal opportunity, OR: 5.02, 95% CI: 1.51-16.70, vs less opportunity).

Conclusions: Our results indicate that residents who lived in a small regional city in Japan with low infection cases experienced psychological distress and irregular dietary habits during the restrictive measures. The association of psychological distress and the prevalence of irregular dietary habits among the population, as shown by this study, could be due to the additive effects of restrictive measures and lifestyle of residents.

Keyword: Dietary behavior, Psychological distress, Restrictions on movements

PAB(T6)-42
Evaluation of the usefulness of the number of vegetable items as a simple indicator of vegetable intake

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Background and objectives: This study aimed to clarify the relationship between the number of vegetables and vegetable intake in daily diet and examine the efficacy of the number of vegetables as a simple indicator of vegetable intake.

Methods: In May 2020, 88 female university students participated in a two-day dietary record survey. We examined their intake of vegetables and the number of vegetable items at home. Correlation coefficients between the amount of vegetable intake and number of vegetable items were obtained. The second survey was conducted using ready-made lunch boxes. Twenty-seven types of lunch boxes containing vegetables sold in convenience stores, supermarkets, department stores, and school cafeterias were used, and the number of vegetable items and vegetable weights in each box were measured. The vegetables were classified using the Standard Tables of Food Composition in Japan 2021 (Eighth Edition). A correlation coefficient between the number of vegetable items and vegetable weight was used in the analysis.

Results: In the dietary record survey, the average number of vegetable items was 5.61 ± 2.466 (2, 12)/day, and the vegetable intake was 202.4 ± 107.99 (0, 524.0) g/day. A positive correlation was found between the number of vegetable items and vegetable intake (ρ = 0.655). The second term of the National Health Promotion Movement in the 21st century (Health Japan 21 [second term]) proposed 350 g as the target of the mean daily intake of vegetables. From the regression equation, a 350-g vegetable intake represents approximately 11 vegetable items. In the ready-made lunch box survey, the average number of vegetable items was 6.7 ± 2.46 (2, 9)/day, and the vegetable weight was 72.8 ± 43.73 (9.0, 175.6) g/day. A positive correlation was found between the number of vegetable items and vegetable weight (ρ = 0.874).

Conclusions: This study found a positive correlation between the number of vegetable items and vegetable weight (intake) in daily diet and ready-made lunch boxes. The number of vegetable items can be used as a simple indicator of vegetable intake (weight).

Keyword: vegetable intake, indicator, daily diet

PAB(T6)-43
Associations of soy food intake with menopausal symptoms, including hot flushes, in Japanese women

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Background and objectives: Soy foods contain isoflavones that are structurally similar to endogenous estrogens and thus have been suggested to alleviate menopausal symptoms. We aimed to assess the associations of soy food intake with menopausal symptoms, including hot flushes, in Japanese women.

Methods: This cross-sectional study included 382 Japanese women aged 40–59 years who participated in a medical health check-up program provided by a general hospital in Gifu, Japan, between 2003 and 2006. Diet, including soy food, was estimated by a validated food-frequency questionnaire. Soy food intake was log-transformed and adjusted for total energy using the method proposed by Willet. Menopausal symptoms were assessed using the Kupperman test of menopausal distress. The associations of soy food intake with menopausal symptoms were determined using the Spearman rank correlation coefficient.

Results: The average (standard deviation, SD) age of study participants was 46.4 (5.3) years. The participants comprised 299 (78.3%) premenopausal and 83 (21.7%) postmenopausal women. The averages (SD) of hot flush severity and menopausal index score were 0.6 (0.8) and 14.4 (8.3), respectively. Soy isoflavone intake was significantly negatively correlated with the hot flush severity (r = -0.12, p = 0.02) and menopausal index score (r= -0.11, p = 0.04) after controlling for age and menopausal status. Soy fermented food intake was significantly negatively correlated with hot flush severity (r = -0.13, p = 0.01) and menopausal index score (r = -0.10, p = 0.046). Soy food intake was not significantly correlated with hot flush severity or menopausal index score.

Conclusions: Our study showed that the intake of soy isoflavones and soy fermented foods were negatively correlated with hot flushes and menopausal index scores in Japanese women. These data suggest that soy isoflavones and soy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

fermented foods might have beneficial effects on menopausal symptoms, including hot flushes, among Japanese women.

Keyword: Epidemiology, Soy food intake, Menopausal symptoms, Hot flushes, Japanese women

Acknowledgements: We thank Dr. Makoto Hayashi, Dr. Noriyuki Takeda, and Dr. Keigo Yasuda.

PAB(T6)-44
Feasibility study of a nutrient profile model to support healthy eating behaviors in Japan: A cross-sectional study focusing on the motivation of behavioral change

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Objective: To assess the feasibility of a nutrient profile model (NP model) in Japan, we used informational materials about the utilization of the NP model, we previously developed, and conducted internet research. **Methods**: In January 2022, an online cross-sectional survey was conducted among 3,000 Japanese consumers, aged 18 years or older. Participants initially responded to questions regarding their characteristics, daily processed food purchases, and use of nutrition facts labels. Thereafter, they read the informational materials about utilization of the NP model and predicted how it would affect their food purchasing behavior. Based on the results of the participants' current motivation for behavioral change, they were divided into seven groups: not interested (n=468), interested but do not intend to improve (n=719), intend to improve (generally, within six months) (n=542), intend to improve in the near future (generally, within one month) (n=248), already making improvements (for less than six months) (n=242), already making improvements (for more than six months) (n=433), and not required to improve because there is no problem with eating habits (n=348). The association between each variable and the motivation to improve eating habits was assessed using the Mantel-Haenszel test for trends. **Results**: Taste (67.7%) and price (57.3%) were the most important factors when purchasing foods; those less motivated to improve their eating habits were more likely to place importance on the appearance, price, and less effort required for processed foods. The higher the motivation to improve dietary habits, higher the frequency of referring to the nutrition facts label, and higher the number of respondents who answered that the markings that warn against overconsumption based on the NP model would influence their food purchasing behavior. Regardless of the strength of motivation, more than 90% of respondents found the informational materials regarding the NP model, easy to understand. **Conclusions**: Our results indicated that the effect of food labeling based on the NP model was higher for individuals with higher motivation to improve their eating habits. It is necessary to further examine how packaging labels can encourage healthy eating behaviors among those who are not interested in improving their eating habits.

Keyword: nutrient profile model, eating behavior, food purchasing behavior

Conflict of Interest Disclosure: Authors declare no conflict of interest.

PAB(T6)-45
Do caregivers understand Demographic and Health Survey infant and young child feeding questions? Cognitive interviewing to improve dietary measurement in Nepal

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Background and objective: Demographic and Health Survey (DHS) findings are key to inform nutrition policy and programs. Without careful testing and adaptation to local contexts, these findings are at risk of inaccurately representing participants' experiences and behaviors. Cognitive interviewing is a research methodology used to assess and improve the cognitive match between a quantitative survey's intent and the respondent's interpretation and response. We used this method to assess comprehension, retrieval, judgement, and response of DHS dietary recall questions for infant and young children feeding.

Methods: We conducted a cross-sectional qualitative study among 60 caregivers of children 6-23 months of age, utilizing semi-structured questions, in three purposively selected districts of Nepal. Caregivers were purposively sampled in all three districts and recruited through local community liaisons. Individual interviews began with the Infant and Young Child (IYC) dietary assessment module and were followed by cognitive interviewing to assess discrepancies in the intent and interpretation of the question. For analysis, we organized data into four cognitive themes and further identified common and distinct themes for each question tested.

Results: We identified five themes of discrepancies in intent of the questions and participants' response. These included (1) Recall: caregivers not understanding that the recall period includes night; (2) Retrieval: could not recall instruction to omit foods consumed in small quantity/used for flavor; (3) Interpretation: tinned and powdered milk were understood as infant formula products or condensed milk; fresh milk was interpreted as milk directly from an animal and consumed within a day; the terms ‘flavored' and ‘sweetened' interpreted same as

sweetening with the addition of sugar (4) Judgement: food items considered unhealthy (sweet food group, sugar sweetened beverages) were associated with negative social desirability potentially leading to bias in response; (5) No specific names in Nepali: participants had difficulty in understanding breast-milk substitutes as inclusive of infant formula, follow-up formula and toddler milk.

Conclusion: These findings will be valuable to improve Nepal-specific infant and young children dietary recall DHS questionnaire. Further, the study findings illustrate that understanding local interpretation of adapted global DHS questionnaires is important to ensure accurate measurement in varying contexts.

Keyword: Cognitive Interviewing, Dietary recall, Infant and Young Child Feeding, Demographic Health Survey, Nepal

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-46
Global changes in Mediterranean Diet Score: A Comparative study of 52 years using international database

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Background and Objectives: While the relationship between diet and non-communicable diseases (NCDs) has been recognized, it is still unclear how diets eaten around the world are changing. In this study, we focused on the Mediterranean diet and examined the changes in the Mediterranean Diet Score (MDS) worldwide from 1961 to 2013, using databases from international organizations on dietary changes.

Methods: Individual countries were scored from 0-9 to indicate adherence to the Mediterranean diet according to the MDS-scoring method by Trichopoulou et al. The supply of vegetables, legumes, fruits and nuts, cereals, fish, and olive oil per 1,000 kcal per country was calculated from the Food and Agriculture Organization of the United Nations Statistics Division database (FAOSTAT), with a score of 1 for above the median and 0 for below. For ethanol, a score of 1 was given for 50 g or more of consumption. Depending on the score, countries were classified into two to six groups using latent class mixed model with random effects of fiscal year. The changes in score from 1961 to 2013 on 170 countries for which all data were available were shown as spline curve.

Results: The results of the optimal model, which consists of 4 groups as determined by the AIC, showed a decline of MDS in countries with the highest scores in 1961, which include the Mediterranean regions. Countries with the lowest scores in 1961, represented by landlocked countries and the Nordics, showed a significant increase in score. The scores did not change drastically in Japan and in many developed countries. Globally, the difference in MDS showed a narrowing trend. Analyses by food group revealed that in Mediterranean countries, the increase in meat and milk supply led to a decrease in score. Meanwhile, in Nordic and landlocked countries, meat and milk supply was still high, but the increase in vegetable and fish supply led to an increase in score. **Conclusion**: These results suggest that there has been a change in access to food worldwide due to the globalization of diet, and the relationship between this change and NCDs needs to be further analyzed.

Keyword: Mediterranean Diet Score, Diet quality, Dietary score, Global study, Longitudinal analysis

PAB(T6)-47
Eater profiles of young adults in Canada based on factors determining eating behaviours

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Background and objectives: A shift in eating behaviours is needed for positive human and planetary health outcomes. However, changing eating behaviours is challenging as food decisions are complex and impacted by both personal and environmental factors. Young adults are a critical target population for shifting diets due to their poor eating habits and because they are in a transition phase where their diets can be influenced. The purpose of this research is to: 1) understand the factors affecting food choices of young adults in Canada based on environmental perceptions, personal, and behavioural factors as determinants of eating behaviours; 2) segment Canadian young adults based on the strength of these factors. The outcomes are important for designing effective interventions for shaping eating behaviours. **Methods**: An online survey was administered to Canadians aged between 18 and 24 to collect data on socio-demographic factors and eating behaviours. An Exploratory Factor Analysis was used to identify the main factors affecting eating behaviours in young adults, followed by K-means clustering to categorize the respondents into consumer segments based on their propensity to agree with the factors. **Results**: There were 297 respondents, with socio-demographic characteristics representative of Canadian population within the same age group. Six factors were extracted: Beliefs (ethical, environmental, personal), Familiarity and Convenience, Joy and Experience, Food influencers and

Sociability, Cultural identity, and Body image. Using these factors, six consumer segments were identified whereby members of each segment has more similar scores on each factor than members of other segments. The six consumer segments were: “conventional”; “concerned”; “indifferent”; “non-trend follower”; “tradition-follower”; and “eat what you love”. The last three categories represent new segments relative to what has been found in the literature. The largest segment was the “conventional” consumer, who is extremely sensitive to the ‘familiarity and convenience' factor (e.g. fast and easy preparation, brand recognition). **Conclusions**: Identifying major factors influencing eating behaviours and consumer segmentation provides insights on how eating behaviours might be shaped. For example, interventions that include changes in the food environment to facilitate access to environmentally sustainable foods could be used for “conventional” consumers.

Keyword: eating behaviours, young adults, consumer segmentation, eater profile

PAB(T6)-48
A simulation model of the effect of changes in salt intake on long-term trends in cardiovascular mortality during the period 1950-2017 in Japan

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Background and objectives: In Japan, a decrease in cardiovascular mortality coincided with that in mean salt intake since the 1950s. The purpose of this study was to quantitatively examine the effect of reduced population salt intake on long-term trends of cardiovascular mortality.

Methods: Using government statistics and epidemiological study results, we developed a system dynamics model of age-specific cardiovascular mortality and salt intake for 20-69-year-olds during the period 1950-2017. Based on the age-period-cohort model, we estimated the period effect of salt intake at that time and the cohort effect of past salt intake and modeled these effects on cardiovascular mortality. We calibrated the historical decrease in salt intake. We then simulated a counterfactual scenario of no decrease in salt intake since the 1950s to estimate the reduction in cardiovascular deaths associated with decreased mean salt intake.

Results: Compared with the counterfactual scenario, observed cardiovascular mortality in the 1950 and 1990 cohort was lower by 2.8% and 4.1%, respectively, for men, and 2.4% and 3.6%, respectively, for women. It was estimated that approximately 208,000 and 115,000 deaths in men and women, respectively, had been prevented through reduced salt intake over the entire period.

Conclusions: The simulation results from the system dynamics age-period-cohort model suggested that decreased salt intake saved about 300,000 adults from cardiovascular death in Japan during the past 67 years. The systems thinking approach will also help examine the effects of future decreases in salt intake.

Keyword: Salt intake, system dynamics , simulation, mortality, Japan

Conflict of Interest Disclosure: None declared

PAB(T6)-49
Development and validation of a diet quality score for Japanese adults

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Background and objectives: Evidence mainly accumulated from Western countries suggests that four diet quality scores (Healthy Eating Index, Alternative Healthy Eating Index, Mediterranean Diet Score, and Dietary Approaches to Stop Hypertension) have protective associations with health outcomes, including mortality, cardiovascular disease, type 2 diabetes, and total cancer. The purpose of this study was to develop a diet quality score for Japanese adults on the basis of these four well-established diet quality scores and to evaluate its validity.

Methods: The present study was based on 4-day dietary record data obtained from 396 Japanese adults aged 20–69 years. For each dietary component included at least in two well-established diet quality scores, we examined the distribution of intake levels in Japanese, in addition to the potential health effect in Japan (using the Global Burden Disease Study). Consequently, the diet quality score consisting of 10 components was developed: fruits, vegetables, whole grain, dairy, legumes, nuts, fish, red and processed meat, sugar-sweetened beverages, and sodium. The total score was the sum of 10 components having a possible range of 0–20, with a higher score indicating a better diet quality. The validity of the diet quality score was evaluated by examining associations with sociodemographic factors and intakes of foods and nutrients.

Results: The mean diet quality score was 9.2 (sd 3.0). A higher diet quality score was observed in women (than men), older (45–69 years) participants (than younger participants), and non-smokers (than smokers). The diet quality score was associated positively with intakes of fruits, vegetables, whole grain, dairy, legumes, nuts, fish, protein, n-3 fatty acids, carbohydrate, total fiber, and most vitamins and minerals, and inversely with intakes of red meat, sugar-sweetened beverages, refined grain, poultry, total fat, and saturated fatty acids, but was not associated with sodium intake. No association was

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DOI: 10.1159/000530786

observed between the diet quality score and energy intake, suggesting its independence of the quantity of diet.

Conclusions: The diet quality score developed for Japanese adults was associated with sociodemographic factors and intakes of most foods and nutrients in expected directions. Further evaluation against biomarkers and health outcomes is warranted.

Keyword: Diet quality, Japan, DASH, Mediterranean diet, Healthy Eating Index

PAB(T6)-50
Eating behaviors and depressive symptoms among Japanese workers

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Background and objective: Recent accumulating evidence indicates that when and how we eat is as important to health as what and how much we eat. For example, skipping breakfast and eating alone have been reported to be associated with increased risk of depressive symptoms. However, few studies have examined the association between eating behaviors and depressive symptoms in Japan. We prospectively investigated the association between eating behaviors and depressive symptoms in a Japanese working population.

Methods: Participants were 914 workers (816 men and 98 women aged 19-68 years) without depressive symptoms at baseline who completed a 3-year follow-up survey. Unhealthy eating behaviors such as skipping breakfast ≧3 times/week, eating dinner within 2 hours before bedtime ≧3 times/week, and snacking after dinner ≧3 times/week were assessed via a health checkup questionnaire. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression (CES-D) scale. Multiple logistic regression was used to estimate the odds ratio of depressive symptoms according to tertile of the number of unhealthy eating behaviors (0, 1, and 2-3) with adjustment for covariates.

Results: At the time of the 3-year follow-up survey, 155 workers (17%) were newly identified as having depressive symptoms (CES-D score ≧16). The odds ratio of depressive symptoms among participants with 2-3 unhealthy eating behaviors was significantly higher than in those without these behaviors, after adjustment for age, sex, and worksite (odds ratio, 1.88; 95% CI, 1.14-3.11). This association was substantially attenuated after adjustment for lifestyle factors, including BMI, marital status, living status, job grade, night or rotating shift work, overtime work, sleep duration, smoking status, alcohol consumption, physical activity, and job stress (corresponding odds ratio, 1.38; 95% CI, 0.78-2.46). After additional adjustment for dietary factors such as folate, vitamin B6, vitamin B12, n-3 polyunsaturated fatty acids, magnesium, and zinc, the odds ratio was 1.36 (95% CI, 0.76-2.44) (*P*for trend = 0.27).

Conclusions: Our results suggest that the increased risk of depressive symptoms associated with unhealthy eating behaviors may be explained by lifestyle factors such as night shift, overtime work, smoking, job stress, and living alone.

Keyword: breakfast, depressive symptoms, eating behavior, Japan

PAB(T6)-51
A Longitudinal Study on the Relationship of Oranges and Mandarins Supply with Life Expectancy and Healthy Life Expectancy: An Ecological Study Using International Data

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Background and objectives: The average life expectancy and healthy life expectancy in many Mediterranean countries are known to be long. The Mediterranean diet is a typical healthy diet. Oranges have been eaten in the Mediterranean region thousands of years. In Japan, where life expectancy is one of the highest in the world, mandarins have been cultivated and eaten. In this study, we aimed to clarify the relationship of oranges and mandarins supply with average life expectancy and healthy life expectancy through longitudinal analysis using data from an international database.

Methods: Average life expectancy (LE) by country was obtained from the World Bank database, and healthy life expectancy (HALE) was obtained from Global Burden of Disease (GBD) database. Oranges and mandarins supply (kg/day/capita) by country, excluding loss between production and household, were obtained from the Food and Agriculture Organization of the United Nations Statistics Division database (FAOSTAT). A cross-sectional association of oranges and mandarins supply with LE and HALE in 2009 was examined controlling for covariates. Longitudinal association of oranges and mandarins supply and interaction between supply and year in 2009 with LE and HALE from 2009 to 2019 were also examined using linear mixed model controlling for covariates. Number of the countries used in the analysis was 140 countries with populations of 1 million or more for which all data were available.

Results: In the cross-sectional model, oranges and mandarins supply was significantly associated with LE (β ± SE; 48.1 ± 15.1, p = 0.002) and HALE (33.2 ± 12.2, p = 0.007). In the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

longitudinal model with the interaction term, the main effects of the supplies on LE and HALE were 66.3 ± 12.0 ($p < 0.001$), and 44.3 ± 10.1 ($p < 0.001$), respectively. The interaction terms were also significant both in LE and HALE ($p < 0.001$).

Conclusions: Oranges and mandarins supply was associated with increase in LE and HALE by cross-sectional and longitudinal analysis. In the longitudinal analysis, the interactions between supply and year were significant, which indicated that the rates of increase in LE and HALE by year were different depending on the supply.

Keyword: Oranges and Mandarins, Life Expectancy, Healthy Life Expectancy, Ecological Study

PAB(T6)-52
Using a SWOT Analysis to determine the problems arising from the operation of the school lunch program in Thailand

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Background and objective: Thai school lunch program (Thai-SLP) has been a national program solving Thai children's nutritional program since 1980. The purpose was to understand barriers and supports of Thai-SLP arising from management, prioritize problems, and possible strategies resolving for the program.

Method: School principal (SP) is the key person formulating clear policies, action plans, and assign various tasks to teachers. Educational local staff from Ministry of Education were responsible for supervision, monitoring, and evaluating program implementation. They exchanged experiences and discussed problems and supports to implementation. Sixty participants were invited from selected 30 medium-sized schools from rural, semi-urban, and urban areas across Thailand and divided into 6 groups for focus groups and in-depth interviews. SWOT Analysis was used to analyze the implementation of Thai-SLP through brainstorming activities.

Results: Key issues of Thai-SLP is that schools should implement proactive strategies. The strengths-opportunities took advantage of the strengths and external opportunities of schools. This strategy was a priority that should be maintained and supported. Adequate budget management, whether it was managed within schools or supported by external agencies, also good collaborating community networks for sustainability. However, barriers was opportunity of weakness-threat, which proposed having nutria-teachers by training for schools related health program supporting reduced teachers' workload. The current situation at schools teachers who are responsible for the program having a teaching workload, also menu planning, purchasing ingredients and serving food. In addition, they were not trained nutritional knowledge or having health background. Budget was another issues, but required multi-stakeholders and community participatory approach.

Conclusion: Thai-SLP is important program for children. The program can alleviated malnutrition problems. However, some obstacles should be concerned and solved by all stakeholders. Top-down or bottom up strategies were required to solve operating problems under the lunch program to improve the quality of school lunches. Priority solution should start with strategies that the school can implement itself. Forming network, building capacity among schools, communities and local government for sustainable management could also improve quality of school lunch program and children's health.

Keyword: SWOT Analysis, strategy, school health, Thai school lunch program

PAB(T6)-53
Risk of hip fracture in meat-eaters, pescatarians, and vegetarians: results from the UK Women's Cohort Study

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Background and objectives: Hip fracture affects 18% of women globally, increases morbidity and mortality, and reduces quality of life. There are growing concerns regarding the adequacy of plant-based diets for bone health, but their association with hip fracture risk is unclear. We aimed to investigate the risk of hip fracture in occasional meat-eaters, pescatarians, and vegetarians compared to regular meat-eaters in the UK Women's Cohort Study, and to determine if potential associations between each diet group and hip fracture risk are modified by body mass index (BMI).

Methods: UK women, ages 35–69 years, were classified as regular meat-eaters, occasional meat-eaters, pescatarians, or vegetarians based on a survey that collected dietary and lifestyle information at recruitment (1995–1998), including a validated 217-item food frequency questionnaire. Incident hip fractures were identified by record linkage to Hospital Episode Statistics up to March 2019. Cox regression models were used to estimate associations between each diet group and hip fracture risk, with regular meat-eaters as the reference, over a mean follow-up time of 21.1 years.

Results: Among 30,244 women, 993 hip fracture cases were observed (637,427 person-years). After adjustment for confounders, vegetarians (HR (95% CI): 1.36 (1.06, 1.75)) but not occasional meat-eaters (1.01 (0.86, 1.19)) or pescatarians (0.99 (0.76, 1.28)) had a greater risk of hip fracture than regular meat-eaters. Hip fracture risk appeared higher in vegetarians with a BMI < 23.5 (1.52 (1.12, 2.07)) than in vegetarians with a BMI > 23.5 (1.04 (0.68, 1.60)), but there was no evidence of effect modification by BMI in any diet group.

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DOI: 10.1159/000530786

Conclusions: Vegetarian women had a higher risk of hip fracture than regular meat-eaters. Further research is needed to confirm this in other populations, and to identify factors responsible for the observed risk difference. In particular, further research exploring the role of BMI and nutrients abundant in animal-sourced foods is recommended.

Keyword: Nutrition, Vegetarian, Hip fracture, BMI, cohort study

PAB(T6)-54
Trends in dietary salt sources in Japanese adults: data from the National Health and Nutrition Survey 2007–2019

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Background and objectives: High salt intake was the leading dietary risk for deaths and disability-adjusted life-years in Japan. Identifying the trends in dietary salt sources is important in order to effectively reduce salt/sodium intake. This study aimed to examine the trends in dietary salt sources in Japanese adults.

Methods: Participants were 95,581 adults (43,129 men and 52,452 women) aged 20 years and over, who participated in the 2007–2019 National Health and Nutrition Survey. Dietary intake data were collected using a one-day semi-weighed household dietary record. Based on previous studies in Japan and other countries, we classified food sources of sodium/salt into 21 groups as follows: grains, bread, noodles, instant noodles, vegetables, pickled vegetables, unprocessed fish and shellfish, dried fish and shellfish, processed fish and shellfish, unprocessed meats, processed meats, seasonings, kitchen or table salt, soy sauce, soybean paste, sauce, soup stock, dressing, mayonnaise, roux, and other seasonings. Salt intake for each food group was adjusted using the density method based on the energy intake. Trends in dietary salt intake based on food sources by sex and age groups (20–39 years, 40–59 years, and 60 years and older) were analysed using the Joinpoint Regression Program.

Results: Salt intake decreased over time between 2007 and 2019. The major dietary source of salt continued to be seasonings such as soy sauce and soy bean paste in all age categories for both sexes (approximately 70%), followed by different food groups according to sex and age. Salt intake from seasonings decreased over time in both men and women aged 40 years and over, but did not change in those aged 20-39 years. In addition, a decreasing salt intake from unprocessed fish and shellfish and an increasing salt intake from unprocessed meat were observed in all age categories among both men and women.

Conclusions: This study demonstrated that a strategy targeting different age groups may be needed to reduce salt consumption from seasonings among the Japanese population. Further studies on the continued monitoring of trends in dietary salt sources including various types of seasonings, occasional consumption and timing are required.

Keyword: dietary salt sources, trend, Japan, National Health and Nutrition Survey

Conflict of Interest Disclosure: None.

Further Collaborators: None.

PAB(T6)-55
Prevalence and modifiable risk factors of non-communicable diseases among traders in major markets in Nigeria

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Background and objectives: Non-communicable diseases (NCDs) are the leading cause of death globally. Available evidence has shown that they significantly affect the economic growth and development of any nation through increased health care cost, and loss of individual/countries productive capacity. Considering the consequences of NCDs, it becomes crucial to monitor the trend of these diseases among populations who play active roles in driving the national economy. This study therefore seeks to determine the prevalence and risk factors of NCDs among traders in major markets in Enugu metropolis, Nigeria.

Methods: Cross-sectional descriptive survey design was adopted and multistage random sampling technique was used to select 514 respondents from major markets in Enugu metropolis, Nigeria. Data on background information, food consumption pattern, and lifestyle behaviours were obtained using questionnaire. Blood pressure and anthropometric measurements of weight, height, waist and hip circumference were also collected. Blood samples were analysed for blood glucose and lipid profile. Data obtained were subjected to statistical analysis using SPSS, version 22. Descriptive and inferential statistics were used to compare and determine the relationship between variables. Significance was accepted at $p < 0.05$.

Results: Obesity (25.5%), overweight (40.7%), hypertension (35.2%), diabetes (15.6%) and dyslipidemia (70.3%) were prevalent among the study population. Factors associated with obesity/overweight were frequency of fruit consumption (OR= 6.00, 95% CI = 1.05 – 16.77), physical activity pattern (OR= 2.27, 95% CI = 1.42 – 3.62) and waist circumference (OR= 0.12, 95% CI = 0.08– 0.19), while dietary diversity (OR= 0.25, 95% CI = 0.07 – 0.95) and knowledge of health status (OR= 4.15, 95% CI = 1.04 – 16.57) were associated with dyslipidemia.

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DOI: 10.1159/000530786

Conclusions: NCDs are highly prevalent among traders in the Enugu metropolis, Nigeria hence the need for nutrition education and health sensitization programmes.

Keyword: Traders, Nigeria, Obesity, Diabetes, Hypertension

PAB(T6)-56
Countries with Mandatory Large Scale Food Fortification Lack Fundamental Elements Important in Legislation, Standards, and Monitoring Documentation

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Background/objectives: One hundred and thirty-seven countries mandate fortification of maize flour, oil, rice, salt, or wheat flour, however, not all programs are well-supported by a legislative and regulatory framework. Mandating fortification is necessary, but not sufficient to a successful program; countries must clearly define parameters of the program's implementation and monitoring. The Global Fortification Data Exchange (GFDx) collates data on Large Scale Food Fortification (LSFF) globally, including documentation on legislation, standards, and monitoring protocols. Through a review of the GFDx repository, we aimed to review how many countries with mandatory fortification had documentation containing key foundational program elements.

Methods: We developed a 19-point check list of items deemed essential to include in a set of LSFF documents, based on a previously published 44-point checklist review process developed for cereal grains (Marks et al.). We reviewed each country's LSFF legislation, standards, and monitoring protocols against the checklist and computed the scores and percentage of elements present for each country. Examples of checklist elements include defined roles/responsibilities of government agencies in fortification, checklists for monitoring protocols, among others.

Results: According to documents available in the GFDx repository, 137 countries mandated fortification of at least one food and were included in this review. Of the 253 country-food combinations, 17(7%) maize flour, 26(10%) oil, 7(3%) rice, 121(48%) salt, and 85(34%) wheat flour countries were included. On average, the score (checklist items fulfilled/checklist items applicable) was 56% across all vehicles. The highest score was achieved by rice with 66%, followed by maize flour(55%), salt(54%), wheat flour(53%), and oil(52%). One major gap observed across all vehicles was in affirmative checklist items related to monitoring protocols, e.g., for both external and import monitoring, roles were clarified between government agencies only 7% and 8% of the time respectively; import auditing checklists were present in only 10% of fortification documentation.

Conclusions: As LSFF programs are planned, implemented, and scaled, it is critical that the foundational structure, as defined in key elements of legislation, standards, and monitoring protocols can support ongoing success and sustainability. Identifying and understanding gaps in key fortification documents could help improve existing mandatory fortification programs/provide countries with a planning framework when developing new LSFF programs.

Keyword: Food Fortification, Data Collection, Data Repository, Fortification Documentation, Fortification Monitoring

Conflict of Interest Disclosure: The authors certify that they have no conflicts of interest, financial or non-financial, in the subject matter or materials discussed in this abstract.

Co-authors are employed with Emory University, the World Food Programme, UNICEF, Centers for Disease Control and Prevention, World Health Organization and the Food Fortification Initiative. All of these organizations help country leaders promote, plan, implement, monitor or evaluate fortification of industrially milled wheat flour or maize flour.

https://www.sciencedirect.com/science/article/pii/S0306919220302025

PAB(T6)-57
Thailand's demographic trend and future greenhouse gas emissions from protein food choices

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Background and objectives: The Sustainable Development Goals have been a global agenda to achieve a better and more sustainable future for all. Food security, nutrition, and well-being were recognized at least 2 goals. Considered the importance of Thailand's population structure and its alteration towards aged society, System Dynamics approach were used to simulate how environmental outcome was influenced by population dynamics and their sources of protein consumption. The link between food systems, public health, and the environmental impact were explored in terms of greenhouse gas emissions (GHGe).

Methods: Lifecycle was made by age group of infants, children, adults and elderly. GHGe were calculated from their protein choices. Population for each age group and their consumption were optimized to actual numbers. GHGe contributed by proportion of protein food sources according to Food-based Dietary Guidelines (FBDGs) considering as inevitable emissions to maintain balance between healthy diets and sustainable consumptions. Protein choices data from the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

national food consumption surveys were added into 5 groups: meats, fish, pulses, milks, and eggs. Simulations were set during the year of 2006-2030.

Results: Meats were increasingly consumed in all age groups, while pulses consumption were decline. Milks were less consumed comparing to FBDGs, especially in elderly. The highest contribution of overall GHGe was from adults specifically by meats consumption since these groups are majority. Scenarios were made by replacing actual food consumption quantity to illustrate how change of GHGe over time. Meats consumption reduction by adults and substituted their energy intake by consuming more pulses, which seem to be the low carbon choices, resulted in decreasing GHGe in early years and projected to slightly rise after 2022. Partially covered meat eating by fish (maintained energy intake) did not decrease GHGe trend. Additional 50% milk intake of actual consumption in elderly to catch up FBDGs did not alter GHGe by the whole population.

Conclusion: These findings suggested that food choices played a critical role not only for health but also environmental impacts. Simulation analysis may be useful when defining leverage points to tackle nutrition problems and exploring effective strategies to promote environmental-friendly healthy eating.

Keyword: Food choice, Food security, Greenhouse gas emission, Sustainable food, Thailand

Conflict of Interest Disclosure: The Authors declare that there is no conflict of interest.

Further Collaborators: None

PAB(T6)-58
Global Longitudinal Study of the Association of Dietary Na/K Ratio with Ischemic Heart Disease Mortality and Incidence

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Objective: The dietary Na/K ratio is one of the indicators used to assess the risk of cardiovascular disease and death. Ischemic heart disease (IHD) is one of the leading causes of death worldwide, and excessive sodium intake and increased potassium intake are considered risk factors and protective factors, respectively. In this study, we aimed to investigate the association of the dietary Na/K ratio with IHD incidence and mortality through a longitudinal study using the latest international data.

Materials & Methods: Per capita sodium and potassium intakes for each country were obtained from the Global Dietary Database 2018, and the dietary Na/K ratio was calculated by dividing sodium intake by potassium intake. Age–standardized IHD mortality and incidence rates per 100,000 population were obtained from the Global Burden of Disease 2019 database. Energy intake, obesity ratio, smoking prevalence, years of education, physical activity, aging rate, and gross domestic product (GDP) per capita were used as controlling factors. The analysis included 149 countries with populations of 1 million or more for which all data were available. We examined longitudinal associations of IHD incidence or mortality with dietary Na/K ratio and interaction with year using linear mixed models over a 28-year period from 1990 to 2018.

Results: The main effect of dietary Na/K ratio on IHD mortality was 13.8±6.9, $p<0.05$, which was a significantly positive association. Also, the main effect of dietary Na/K ratio on IHD incidence was significantly positively associated with 16.2±6.3, $p<0.05$. Furthermore, the interaction between dietary Na/K ratio and year and the incidence of IHD was 1.32±0.39, $p<0.001$, and dietary Na/K ratio of 1.1 or less was associated with a significantly lower incidence of IHD over 28 years.

Conclusion: This study suggests that higher dietary Na/K ratios may increase the IHD incidence and mortality. Avoiding excessive sodium intake or increasing potassium intake to lower the dietary Na/K ratio may be protective against IHD.

Keyword: Longitudinal analysis, Global study, Dietary sodium potassium ratio, Ischemic heart disease

PAB(T6)-59
Health survey of Japanese and Chinese university students under effects of COVID-19

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[Background and objectives] The epidemic of the COVID-19 has significantly changed people's lifestyles. There is a high possibility that lifestyles have changed in all generations, such as loss of opportunities to go out and changes in eating habits. The purpose of this study is to clarify the lifestyle and health conditions of university students in Japan and China under effects of COVID-19.

[Method] Surveys related to lifestyle / health and eating habits were conducted with 47 questions of "(DIHAL.2)" and 9 questions originally created for 319 Chinese and 98 Japanese.

[Results] In China and Japan, the mean score of taking exercise was 32.3±5.0, 25.7±5.9, the mean score of diet was 51.3±8.3, 44.1±8.8 , the mean score of having a rest was 53.6±10.0, 45.9±9.2 ($p<0.001$), respectively. In the each classification of lifestyle and health, full-fledged was 62%, 42%, being aware of the type was 14%, 36%, which indicated that the

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DOI: 10.1159/000530786

health level of Chinese students was better than Japanese.17% of the students in China and 18% in Japan answered that their physical condition was "worse" than before the COVID-19, and 36% of the students in China and 25% in Japan said that they had gained weight. 35% Chinese students were being aware of type, responded about their physical condition was "worse" than before, however, there were 61% in Japan. 25% Chinese students were being precautionary type who responded that their weight had "gained" compared to 42% in Japan. With nutritional knowledge, the percentage of those who were well-informed was higher than those who were not well-informed, and there was an association with lifestyle and health, especially in China

[Conclusions] Although the lifestyle and health of Chinese students were good compared with Japanese, it was shown that the degree of knowledge about changes in physical condition and nutrition due to COVID-19 is related to the health of students. Many of the university students in China live in dormitories, suggesting that the environment may lead to desirable lifestyles and high health even in COVID-19.

Keyword: COVID-19, Health, University student, Lifestyle, Habits

PAB(T6)-60
Applying the concept of the Thai nutrient-profiling to develop the Thai school lunch planning program for lay-teachers

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Background and objective: Although teachers who were responsible for the school lunch program were trained by the staff of Ministry of Education (MOE), they were not equipped with the basic knowledge of nutrition for children. This study aimed to develop the Thai school lunch planning program based on nutrient-profiling for lay-teachers.

Methods: We collected 52 Thai popular school lunch menus from outsource company where managed lunch for students in Bangkok. All menus were determined in 2 portion sizes for kindergarten and for students. The menus also were calculated nutrients contents by the Thai food composition software (INMUCAL-v 4.0). The menus were classified by characteristic of foods and cooking methods, such as clear soup, stir flied vegetable, hot and spicy soup/curry with or without coconut milk. The menus were calculated scores based on Thai nutrient-profiling criteria, which were 'grade A' (score >16), 'grade B' (12-16), and 'grade C' (score <12). Thai school lunch guideline was used to manage the patterns.

Results: The Menus were classified in 9 groups; single dish, curry/soup with or without coconut milk, stir-fried foods, deep-fried foods, spicy salad, steamed food, fruits and Thai desserts. None was passed the 'grade A'. Forty-five menus were accepted to 'grade B' while 7 menus were accepted to 'grade C'. When we developed an algorithm for lunch patterns, we found 153 patterns in total. However, 120 possible lunch patterns were passed the Thai school lunch guideline. Thirty-three percent (n=40) lunch patterns were passed the macronutrient for 30% while the less needed to improve some nutrients.

Conclusion: This study was applied the concept of nutrient profiling on the domain of Thai school lunch planning program to help lay-teachers gained a better understanding of the nutrition in school lunch menus and maximize the nutritional value of their choices. We expect that this tool will be usable, and that all of its interfaces are easy to understand for lay-teachers.

Keyword: Thai school lunch program, Nutrient profiling, Lay-teachers, Menus

PAB(T6)-61
Global ecological study on Traditional Japanese diet score and SDGs

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Background and objectives: Reducing the environmental impact of the food supply is important for the SDGs in the world. We developed the Traditional Japanese Diet Score (TJDS) and reported in a global ecological study that Japanese food is associate with reducing obesity and extending healthy life expectancy (Imai et al. J Nutr Health Aging. 2019). We conducted an ecological study to examine whether Japanese food contributes to sustainability, using the TJDS and environmental indicators.

Methods: Average food (g/day/capita) and energy supply (kcal/day/capita) by country were obtained from the Food and Agriculture Organization of the United Nations Statistics Division database (FAOSTAT) from 1990 to 2013. TJDS was calculated from eight food groups (beneficial food components in Japanese diet; rice, fish, soybeans, vegetables, and eggs, food components that are relatively unused in traditional Japanese diet; wheat, milk, and red meat) by country and calculated the total score from -8 to 8, with higher scores means greater adherence to the TJDS. As for environmental indicators, we used Greenhouse gas (GHG) emissions 2013 (kg CO_2eq), Land-Use (m^2), Acidifying Emissions (Acid; g SO_2eq) per food weight by Poore et al. (Science 360, 2018), and multiplied these indicators by the average food supply of FAOSTAT in each country to obtain the environmental impact of food supply. Latitude was derived from

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DOI: 10.1159/000530786

the Global Burden of Disease 2019 database. We evaluated the cross-sectional association between TJDS and 3 environmental indicators in 2013, and the longitudinal association between TJDS and 3 environmental indicators from 1990 to 2013 using linear mixed-effect model. This study covered 138 countries with populations of 1 million or greater.

Results: GHG (β ± standard error; -0.232 ± 0.070, p=0.001), Land-Use (-0.882 ± 0.175, p<0.001), and Acid (-1.215 ± 0.380, p=0.002) were negative associated with TJDS after controlling for energy supply and latitude in 2013 data. In longitudinal analysis, GHG (-0.083 ± 0.010, p<0.001), Land-Use (-0.243 ± 0.026, p<0.001), and Acid (-0.463 ± 0.055, p<0.001) were negative associated with TJDS after controlling for confounders.

Conclusions: This ecological study suggests that the traditional Japanese dietary pattern might have associated with SDGs.

Keyword: Traditional Japanese diet score, SDGs, Greenhouse gas emissions, cross-sectional analysis, longitudinal analysis

PAB(T6)-62
Association between dietary pattern and prevalence of depressive symptoms among community dwelling Japanese pregnant women: a cross-sectional study

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Background and objectives: Dietary pattern may affect to mental health condition during pregnancy. We aimed to clarify the association between dietary pattern and the prevalence of depressive symptoms among community-dwelling Japanese pregnant women.

Methods: The study included community-dwelling pregnant women recruited from July 2019 to December 2021 in Ebetsu, Hokkaido, Japan. Data on food intake, sociodemographic and socioeconomic factors, lifestyle factors, and health status during the gestation period were obtained using self-administered questionnaires that were handed over to participants on notification of their pregnancy. Depressive symptoms were assessed using the validated Japanese version of the Kessler 6 scale. Participants with a history of depression or other mental illnesses were excluded, and finally, 638 participants were eligible for this study. A validated brief-type self-administered diet history questionnaire and factor analysis were used to identify dietary patterns. The association between dietary pattern and prevalence of depressive symptoms was examined using multiple logistic regression analysis.

Results: The mean ± standard deviation of the gestation period was 15.4 ± 9.0 weeks. Three different dietary patterns were identified. The first pattern included fish, potatoes, beans, and vegetables and was named the healthy Japanese food pattern. The second pattern included confectioneries, spaghetti, and fruit and vegetable juice and was named the snack pattern. The third pattern included citrus fruits, persimmons, strawberries, kiwis, and other fruits and was named the fruit pattern. The first to third dietary patterns accounted for 25.2% of the total variance. Each dietary pattern was categorized into low, middle and high scoring groups based on tertiles of the factor scores. A multiple logistic regression analysis showed that after adjusting for potential confounding factors, the odds ratio and 95% confidence interval (CI) of the high score group in the healthy Japanese food pattern was 0.56 (95% CI, 0.34–0.90) compared with those of the low score group. Other dietary patterns were not significantly related to the prevalence of depressive symptoms.

Conclusions: We found that the healthy Japanese food pattern may useful to the prevention of depressive symptoms among Japanese pregnant women. This study was supported by the JSPS KAKENHI Grant, number: JP19K19465.

Keyword: Pregnancy, Mental health, Nutritional epidemiology

PAB(T6)-63
Parents' communication with teachers about food and nutrition issues of primary school students

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Background and objectives: Globally, many primary school-aged children have nutritionally deficient diets, with low vegetable intakes and excessive consumption of energy-dense and nutrient-poor foods and beverages. Dietary habits are usually established in early childhood and track over time into later life. Parents and teachers have a major influence on the formation of these habits. Although the cooperation of parents and teachers has frequently been emphasised in the promotion of healthy eating habits among primary school children (5-12 years old), little is known about the communications between these two groups regarding food and nutrition related issues. This study explored parents' communication with and expectations of teachers in the Australian context. Methods: An online nationwide cross-sectional survey of 787 parents (M_{age} = 40 years, 95 % female, 72 % university degree) was conducted in Australia between March and April 2021. Descriptive statistics were calculated for the survey responses using SPSS software. Results: Parent-teacher communications involved various topics, including allergies, children's lunchbox content and parents' supervision requests for their children while eating their lunch. Parents mainly expected teachers to ensure their children were given enough time to eat their lunch (89%), teach healthy eating (89%), and model healthy eating (79%). Only a few parents preferred to receive feedback from teachers about the

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DOI: 10.1159/000530786

content of the lunch box (17%). Conclusions: These findings highlight the need to enhance communication between parents and teachers in order to promote healthy eating among primary school children. Teachers should be supported through pre-service and in-service training to develop their social and communicative skills to cooperate effectively with all types of parents regarding food and nutrition related issues.

Keyword: Food and Nutrition, Communication, Parent, Teacher, Primary school

Conflict of Interest Disclosure: None.
Further Collaborators: None

PAB(T6)-64
Improving Nutri-Score (Front-of-Pack nutritional label) classifications of foods through food reformulation.

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Background and objectives: Unhealthy dietary patterns are a major risk factor for non-communicable diseases. To improve consumers' health, several strategies can be used to aid consumers to make healthy food choices. One strategy is the implementation of a Front-of-Pack nutritional label, such as Nutri-Score. Based on a scientific algorithm, Nutri-Score classifies foods by means of letter codes A (dark green) to E (red) according to the nutritional quality. A secondary objective of Nutri-Score is to stimulate food reformulation by producers. This study examines the impact on Nutri-Score classifications of foods after food reformulation and investigates whether Nutri-Score would be an incentive to producers to improve foods.

Methods: Nutri-Score classifications were calculated for foods included in the Dutch Reformulation Monitor 2020. This monitor assessed changes in food composition between 2018 and 2020, after agreements were made with the industry to improve foods. Food composition data of these foods were available from the Dutch Branded Food database from 2018 and 2020. The final sum of points calculated with the Nutri-Score algorithm and the corresponding classifications allocated to foods were compared between 2018 and 2020. The percentage of foods with improved, unchanged or deteriorated Nutri-Score classifications were calculated.

Results: The percentage of foods with improved, unchanged or deteriorated Nutri-Score classifications in 2020 compared to 2018 varied between food groups. For three quarters of the foods, Nutri-Score classifications did not change. Improvements in Nutri-Score classifications were observed for bases (pizza bases, wraps), spring rolls (savory snack), formed crisps and gingerbread after reformulation of salt or saturated fat contents. Except for gingerbread, agreements on lowering nutrient contents exist for these food groups. Nutri-Score classifications for these food groups ranged over multiple classes (A to D/E). Up to 21% of the foods shifted towards a better Nutri-Score classification. Deteriorated classifications were observed in a variety of food groups at low percentages.

Conclusions: Improved Nutri-Score classifications were particularly observed in food groups for which reformulation agreements exist and for which classifications range over multiple classes. Depending on food group, reformulation could result in improved Nutri-Score classifications. Therefore, Nutri-Score may be an incentive for food reformulation to producers.

Keyword: Front-of-Pack nutritional label, Nutri-Score, food reformulation, dietary pattern, food choice

Conflict of Interest Disclosure: From 2021, Elly Steenbergen is member of the international technical committee of Nutri-Score.

From 2021, Elisabeth H.M. Temme is member of the international scientific committee of Nutri-Score.

PAB(T6)-65
Introducing iron-folic acid supplements through community-based intervention improves pregnancy outcome

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Background and objective: BRAC is implementing community-based reproductive healthcare interventions across Bangladesh covering around 80 million population. In 2021, 457,895 pregnant women were enrolled and received antenatal care from community health workers (CHW). Majority of them are located in rural areas and urban slums belonging to poor to low socio-economic group. This paper presents findings on the impact of this program on birth outcomes.

Methods: Data from the year 2021, collected digitally by CHWs, was analysed in R programming for descriptive and bivariate analysis. Dependent variable was iron-folic acid (IFA) consumption. A p value of less than 0.05 was considered as significant. Wilcoxon rank sum test and Pearson's Chi-squared test Chi-square test was done calculation of rates.

Results: A total of 14,930 mothers had abortion or miscarriage, the rate was significantly high (4.8% vs 3.3%, p value <0.05) among mothers who did not take IFA regularly compared to those who did. Stillbirth rate was apparently low in the intervention area, however, for those who had taken IFA the rate was lower (2.1% vs 1.5%, p value <0.05). This was also evident that c-section rate was also lower among mothers consumed IFA (34% vs 30%, p value <0.05).

Conclusions: Results showed that IFA consumption at pregnancy improves pregnancy outcomes by reducing miscarriage/abortions, still births and reduces the chances of c-section rate which itself can give rise to many complications. CHWs were able to successfully encourage pregnant women to

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DOI: 10.1159/000530786

consume IFA with repeated interaction and making IFA accessible to them. Women's connectedness with local community clinics and primary public healthcare system might also enabled them to access to IFA free of cost. Community-based interventions are effective to positively change the behaviour of IFA consumption even among less privileged women.

Keyword: Iron-folic acid, Community-based intervention, Birth outcome, Community Health Worker, Bangladesh

Conflict of Interest Disclosure: I have no conflict of interest to declare

Further Collaborators: N/A

PAB(T6)-66
Association between selection behavior for food purchase channels and food intake frequency in women aged 20–49

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Background and objectives: Previous studies suggest that individual access to grocery stores influences people's eating habits. However, few reports in Japan consider the qualitative characteristics of accessible grocery stores and target young people. This study focused on the quality of grocery stores that are actually used by women aged 20–49 in the Chugoku region of Japan and examined their relationship with eating habits.

Methods: In July 2020, we conducted a questionnaire survey on women aged 20–49 residing in Hiroshima and Okayama prefectures. Of the 1110 responses obtained, 1077 were valid and thus analyzed. Questions included respondents' age, family structure, annual household income, and names of frequently used food retail stores(up to three stores). From the obtained data, an index of food intake frequency was created, and the respondents were divided into a low group (≦3) and a non–low group (>3) according to the score. The retail stores in the responses were classified into four types according to their management characteristics. Thereafter, the quality of the stores most frequently used for food purchases and the relationship between the number of stores used and the above index were examined using the Chi–square test.

Results: The average food intake frequency was 3.77. The greater the number of food purchasing channels, the higher the food intake frequency score. The group that used a major supermarket as the first-use store had significantly more people with low scores, and the group that used small-scale / local supermarkets tended to have fewer people with low scores. Also, there was no significant difference in the types of stores selected by income group.

Conclusions: The results suggest that the behavior of consumers who buy at multiple stores enables a variety of food intakes. And the fact that many major supermarket users score lower than small-scale / local supermarkets suggests that quality factors may be more relevant than the quantity of food sold. A more detailed analysis should be considered, including the distance traveled to the store and the quality of food sold.

Keyword: food intake frequency, purchase channels, major supermarkets, small-scale/local supermarkets , quality of the food

Further Collaborators: Macromill, Inc.

PAB(T6)-67
Food security and health behaviour of elderly people in India

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Background and objectives: In India many people have uncertain access to adequate quantity and quality of food due to constrained resources, either temporary or on a chronic basis. Also, food availability, variety, and quality are often not enough to meet household needs. The specific objectives of this study are to see the association between some domains of food & nutrition security of the elderly i.e., skipping meals or reducing size of meals, getting enough food of their choice, hungry but didn't get food due to shortage in the household, didn't get food for a whole day, etc. and elderly health behaviour i.e., tobacco habits, depression status etc.

Methods: The data used in this study comes from the recently completed Longitudinal Ageing Survey of India (LASI, 2017-18). The LASI is a large-scale, nationwide survey of the health, economic, and social drivers of elderly people and their consequences. The LASI gathered the data of 31168 elderly aged 60 and above from all Indian states.

Results: The elderly who didn't eat enough food of their choice was significantly associated with their gender, marital status and inter-generational living arrangement. Food and nutrition insecurity of the elderly were found to be significantly associated with elderly worsening the feeling of being sad, blue and depression. The elderly who couldn't eat for a whole day in last 12 months due to shortage of food in household or hungry but didn't eat were significantly more using the tobacco products mainly in raw form.

Conclusions: From the results it is found that elderly people need a sympathetic, sharing attitude and behaviour from their family members and govt attention regarding their food and nutrition security. Also, the female elderly who are living lonely, not currently married and in low wealth quintile require special attention by the government. It is also seen that food and nutritional insecurity leads to depression among them and as a result might using cheap and highly injurious tobacco products to reduce the appetite.

Keyword: Food and nutrition security, Health behavior, Tobacco products, Depression

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: None
Further Collaborators: Nil

Conclusions: The experiences of *Ho* community may be utilized for understanding characteristics of this community's food system that offer resilience and inform development of future relief packages for indigenous communities, contextualized to diverse food environments, traditional farming patterns, and access to local markets.

Keyword: COVID-19, Indigenous communities, Food systems, Food security, Ho tribe

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: NA

PAB(T6)-68
Impact of second-wave of COVID-19 pandemic on the food systems of *Ho* indigenous community, Jharkhand, India

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Background and Objectives: India experienced second wave of COVID-19 pandemic from April to June 2021, which led to spiralling cases, increased deaths and consequently, state-imposed lockdowns. This impacted the lives of Indian indigenous communities, particularly the smallholder farm communities, disrupting their sustenance and livelihood. A study was undertaken to explore the impact of second-wave of COVID-19 pandemic on food environment, diets and food security of *Ho* indigenous community of Jharkhand, India.

Methods: A cross-sectional household survey was conducted in September 2021 in randomly selected villages of West Singhbhum district, Jharkhand. The survey elicited information regarding the perceptions on impact of COVID-19 second wave on household food security, income, and farming systems. The survey tool was incorporated in CS-Pro software, version 7.6 and administered by local *Ho* field investigators. The data was analysed in R software.

Results: A total of 214 *Ho* households were surveyed, amongst which 50% households experienced hardships in accessing cultivated and wild food environment, while 89% households faced difficulties in accessing local markets during second-wave of COVID-19 pandemic. About 73% households claimed improved distribution of dry ration while 70% households reported receiving additional free rations through Government's food supplementation programs during COVID-19 second-wave. About 79% households experienced a reduction in income due to reduced sales of farm and wild produce, lack of opportunities for daily wage labouring, and restrictions on migration. A few households (8-12%) reported selling of farm and wild produce in local weekly markets for additional income. About 67% households reported reduced food consumption, attributed to increased food prices, reduced income and closure of weekly markets. Although majority of households (74%) did not experience an impact on farming practices, few households (18%) reported engaging family members for labour, 17% households started using organic manure, 15% households shifted to indigenous seeds for cultivation and 8% households resorted to early/delayed sowing of the crops.

PAB(T6)-69
Workplace cafeteria and other multicomponent interventions to promote healthy eating among adults: A systematic review

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Background and objectives: The objective of this review is to evaluate evidence for the effectiveness of workplace cafeteria and other supporting multicomponent interventions to promote healthy eating and reductions in health risks among adults.

Methods: We conducted an electronic search in EMBASE, CINAHL, EconLit, Ovid, Cochrane, Web of Science and PubMed for English-language articles published from 1985 to July 2019. Studies were original articles reporting the results of workplace cafeteria interventions to promote healthy eating and reduction in health risks. Outcomes were classified as changes in fruit and vegetable intake, health risk indicators, dietary intake, and food sales. Interventions were categorized as interventions targeting food quality or quantity, targeting price, targeting food choice at point of purchase, targeting improved supply, targeting client's information, education or motivation and targeting organization policies. Behavioral change conditions used in interventions were identified using the COM-B system of behavioral change.

Results: Results were presented in a narrative summary. A total of 55 studies out of 6285 articles were identified for this review. Several studies used multicomponent interventions and the most featured interventions included interventions targeting food quality or quantity, targeting client's information, education or motivation and targeting food choice at point of purchase. There is evidence that workplace cafeteria and other supporting multicomponent interventions resulted in higher intake of fruit and vegetables, improved dietary intake, improved health outcomes and healthy food sales.

Conclusion: The findings of this review have the potential to inform future cafeteria-based and other supporting multicomponent workplace health interventions.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Cafeteria, Workplace, Environmental intervention

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-70
Relationship between green tea beverages and cedar pollen reactivity: a population-based large cohort study

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Background and Objectives: Green tea is a beverage that Japanese people are familiar with, and it has reported benefits on a wide range of diseases such as lifestyle-related diseases, infectious diseases, and allergies. Although, beverages containing catechins are reported to have a favorable effect against allergic factors, there is a lack of epidemiological evidence. Therefore, the present study examined the association between the intakes of several kinds of teas and allergic diathesis due to cedar pollen.

Methods: The cross-sectional data of 16,623 subjects (6,306 men; 10,317 women) who were included in the Tohoku Medical Megabank Cohort from January 2012 to December 2015 were used in the present study. We analyzed the association between intake frequency (G1: less than once a week; G2: once to six times per week, G3: more than once a day) of several types of teas (green tea, coarse tea, oolong tea and black tea) and the serum level of cedar pollen-specific immunoglobulin E (IgE; Lumicount <2.78 or ≧2.78) using a logistic regression model.

Results: A high intake frequency of green tea and coarse tea was significantly inverse associated with a high serum level of cedar pollen-specific IgE. In comparison to G1, a significant difference was seen with G2 (p<0.001, odds ratio [OR]=0.89, 95% confidence interval [CI]=0.817-0.976), and G3 (p<0.001, OR=0.69, 95%CI=0.64-0.75) for green tea, and with G2 (p<0.01, OR=1.27, 95%CI=1.17-1.37), and G3 (p<0.01, OR=1.26, 95%CI=1.16-1.38] for coarse tea. In contrast, no statistically significant association was seen with oolong tea or black tea.

Conclusion: Our results showed a significant inversely association between a high cedar pollen-specific IgE level and intakes of green tea and coarse tea. Thus, these teas may have a potential effect against allergic diathesis. Further analyses are required to determine the causal relationship between the teas and the cedar pollen-specific IgE level.

Keyword: Japanese, green tea, coarse tea, serum level of cedar pollen-specific IgE level

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-71
Association between low carbohydrate diet score and incidence of type 2 diabetes among Japanese adults The JACC study

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Background and objectives: Most of the studies included in the meta-analysis examining the association between low–carbohydrate diet (LCD) and the development of type 2 diabetes (T2D) were conducted in non–Asians. Thus, the results of previous meta-analysis study may not be applied to Asians including Japanese who consume more carbohydrates than non–Asians. Therefore, we prospectively examined the association between LCD score and T2D risk in Japanese adults in Asia using Japan Collaborative Cohort Study for Evaluation of Cancer Risk (JACC Study) data.

Methods: A total of 19,099 (7,051 in men and 12,048 in women) Japanese non–diabetic participants aged 40 to 79 years, who enrolled in the JACC study between 1988 and 1990, were included. Dietary intake was evaluated by using a validated food–frequency questionnaire. The overall, animal, and vegetable LCD scores were calculated by dividing the study participants into eleven categories based on the percentages of energy from carbohydrates, protein, and fat. A higher score indicated a higher proportion of energy intake from protein and fat and a lower proportion of energy intake from carbohydrates. T2D was assessed using self–questionnaire. We used the multivariable logistic regression to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) of incident T2D across the quintiles of each LCD scores with adjustment for potential confounders. All analyses were conducted separately by sex.

Results: During the five–year period, 491 adults (247 in men and 244 in women) developed T2D (2.6%). The multivariable–adjusted OR of incident T2D for the highest versus lowest quintiles of overall and animal LCD scores were 0.65 (95% CI 0.42–0.99) and 0.83 (95% CI 0.55–1.27) for men, respectively, and 0.78 (95% CI 0.51–1.19) and 0.84 (95% CI 0.57–1.24) for women. Vegetable LCD score was associated with a decreased risk of T2D only in men [OR: 0.51; 95% CI: 0.33, 0.77].

Conclusions: Overall, animal LCD scores did not increase with the incidence of T2D in both sexes, while vegetable LCD score was associated with the lower incidence only in men. Our results suggest that LCD unlikely increases the T2D risk among Japanese.

Keyword: low carbohydrate diet, Asia, Japanese, diabetes, epidemiology

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-72

Evaluation of dietary aflatoxin exposure of lactating mother-child pairs and nutritional status of breastfeeding children 0-6 months in Makueni County, Kenya

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Background and objectives: Aflatoxins once ingested, they are transferred into breast milk, urine and tissues. Their accumulation can lead to malnutrition, aflatoxicosis, or cancer which are predominant in sub-Saharan Africa. South-eastern region of Kenya is prone to aflatoxin outbreaks yet exposure levels of vulnerable population such as breastfeeding children and lactating mothers remain unclear. Objective of this study was to determine the exposure of lactating mothers and breastfeeding children to aflatoxin and its influence on their nutritional status.

Methods: A descriptive cross-sectional study with an analytical component was conducted. Information on socio-demographic characteristics, dietary habits, breastfeeding practices, maize handling and storage practices, and weight of 170 lactating mother-breastfeeding child pairs were collected using structured questionnaire. A total of 48 breast milk and urine samples were collected from a sub-group of respective lactating mothers whose food samples were picked for analysis. Aflatoxin was quantified using enzyme linked immunosorbent assay (ELISA). Statistical analysis was done using the Statistical Package for Social Sciences (SPSS) with significance level set at $p< 0.05$.

Results: Forty five percent (45.3%) of lactating mothers were from low socioeconomic status. Mean women dietary diversity was low (3.4, *SD* = 1.5). Exclusive breastfeeding rate was 44.1%. About 50% never treated their maize, and at least 20% stored maize in containers that promote aflatoxin contamination. Aflatoxin was detected in 85.4% (41/48) food samples. Mean concentration of total aflatoxin was 97.8 mg/kg (*SD,* 57.7), and aflatoxin B1 was 9.0 mg/kg (*SD*, 7.7). Aflatoxin M1 was detected in 77.1% (37/48) in breast milk with a mean concentration of 35 ng/l (*SD*, 0.0). All urine (100%) had aflatoxin M1 with a mean of 0.39 ng/ml (*SD*, 0.16). No significant correlation was reported between weight-for-age z-scores of children with aflatoxin exposure ($p_{all} > 0.05$).

Conclusions: This study concludes that mothers' diet exposed exclusively, and non-exclusively breastfeeding children aged 0-6 months to high aflatoxin intake in the study area. As a result, knowledge, attitude and practices that mitigate aflatoxin contamination in diets and breast milk of lactating mothers as well as clear county government policy on sale and distribution of aflatoxin contaminated maize should be introduced in the study area.

Keyword: Dietary aflatoxin exposure, aflatoxins, lactating mothers, breastfeeding children, Kenya

Conflict of Interest Disclosure: I might consider publishing part of this work this year.

PAB(T6)-73

Environmental enteric dysfunction and small intestinal histomorphology of stunted children in Bangladesh

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Background and objectives: There is lack of information on the histological characteristics of intestinal mucosa in Bangladeshi children, which is considered to be the traditional gold standard for diagnosis of environmental enteric dysfunction (EED). The purpose of the study was to evaluate the intestinal histological characteristics of stunted children aged between 12-18 months with possible EED.

Methods: 110 children with chronic malnutrition (52 stunted with length-for-age Z score, LAZ<-2 and 58 at risk of stunting with LAZ <-1 to -2) from the Bangladesh Environmental Enteric Dysfunction (BEED) study protocol who underwent upper gastrointestinal (GI) endoscopy were selected for this study. To explore the association of EED with childhood stunting, upper GI endoscopy was done and the biopsy specimens were studied for histopathology. Villous height and crypt depth were measured and the presence and intensity of inflammatory infiltrates in the lamina propria was investigated. Bivariate analysis was performed to examine the relationship between stunting and histologic morphology.

Results: More than 90% children irrespective of nutritional status were diagnosed to have chronic non-specific duodenitis on histopathology. Half of the children from both groups had villous atrophy as well as crypt hyperplasia and lymphocytic infiltration was present in more than 90% children, irrespective of groups. However, no statistically significant difference was observed when compared between the groups.

Conclusions: The prevalence of chronic non-specific duodenitis in Bangladeshi children, irrespective of nutritional status, was high. A significant number of these children had abnormal findings in intestinal histomorphology.

Keyword: Malnutrition, Stunting, Environmental enteric dysfunction, Intestinal histomorphology, Bangladesh

Conflict of Interest Disclosure: The authors declare no conflict of interest

Further Collaborators: N/A

Conflict of Interest Disclosure: none

PAB(T6)-74
Natural food environments of Santhal indigenous communities of Jharkhand, India, and their potential for improving micronutrient status

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Background and objectives: The Santhal indigenous communities of Jharkhand have a high prevalence of micronutrient malnutrition among women of reproductive age (WRA). This is despite possessing extensive knowledge about their natural food environment, which are potentially rich and diverse sources of nutrition. The objective of this study was to understand the potential of natural food environments to contribute to improved micronutrient status.

Methods: A cross-sectional study was conducted among WRA of Santhal communities (n=212) from 17 randomly selected villages in the Godda district. Research activities included HH survey for information on the socio-demographic profile and food environment; dietary surveys-using 24-hour dietary recalls, and collection of capillary blood samples. Blood samples were analyzed by Luminex based method for selected micronutrients. Bivariate analysis was done for exploring the associations of biomarkers with the food environment characteristics. The associations, statistically significant at p-value < 0.05 were transferred to the LMER model for multivariate analysis.

Results: The food environment of Santhal community consisted of diverse food sources-agricultural land (92.5%), kitchen garden (*baari*) (71.3%), water bodies (55.7%), and forests (54.3%). However, the diversity in access to food from these sources expressed as FADI, an agroforestry diversity index, was low. The dietary diversity of women expressed as MDD-W was also low. The mean nutrient intake was less than the EAR for each nutrient, thus reflecting inadequate nutrient intake. Approximately 70% women were anemic based on hemoglobin levels and 73.2% had ferritin levels less than 30 ng/ml. Half of the women were Vitamin A insufficient, while 28.4% were deficient based on levels of Retinol Binding Protein (RBP). The LMER model showed that HH access to *baari* was positively associated with RBP levels, and access to ponds with the ferritin levels. The women accessing *baari* had 18.53% higher level of RBP (p<0.05, 95% CI: 2.33, 36.21). Women accessing ponds had 27.12% higher ferritin levels (p=<0.05, 95% CI: 1.82,58.57).

Conclusions: Our findings support the potential of indigenous foods from natural food environments like *baari* and water bodies in contributing to improved micronutrient status. Strategies are required to promote their cultivation and increase awareness on their nutritional benefits.

Keyword: Indigenous foods, Santhals, Natural food environments, Nutritional Biomarkers

PAB(T6)-75
Poverty and food insecurity in Amazonian children associated with SARS-CoV-2 infection and COVID-19

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Background and objective: The nutritional associated factors with childhood SARS-CoV-2 infection and COVID-19-related illness remains little studied in high-transmission tropical settings, partly due to the less severe clinical manifestations typically developed by children and the limited availability of diagnostic tests. We investigate the prevalence and risk factors for infection (either symptomatic or not) and disease in 5 years-old Amazonian children.

Methods: We estimated SARS-CoV-2 attack rates and the proportion of infections leading to COVID-19-related illness among 660 participants in a population-based birth cohort study in the Juruá Valley, Amazonian Brazil. Children were physically examined, tested for SARS-CoV-2 IgG and IgM antibodies, and had a health questionnaire administered during a follow-up visit at the age of 5 years in January or June-July 2021. Evidence of household food insecurity defined when household members have "no access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" were assessed using a validated, 5-question version of the Brazilian Food Insecurity Scale.

Results: We found serological evidence of past SARS-CoV-2 infection in 297 (45.0%; 95% confidence interval [CI], 41.2-48.9%) participants, but only 15 (5.1%; 95% CI, 2.9-8.2%) of the seropositive children had a prior medical diagnosis of COVID-19 reported by their mothers or guardians. The period prevalence of clinically apparent COVID-19, defined as the presence of specific antibodies plus one or more clinical signs and symptoms suggestive of COVID-19 (cough, shortness of breath, and loss of taste or smell) reported by their mothers or guardians since the pandemic onset, was estimated at 7.3% (95% CI, 5.4-9.5%). Children from the poorest households and those with less educated mothers were significantly more likely to be seropositive, after controlling for potential confounders by mixed-effects multiple Poisson regression analysis. Likewise, the period prevalence of COVID-19 was 1.8-fold (95%, CI 1.2-2.6-fold) higher among participants exposed to food insecurity and 3.0-fold (95% CI, 2.8-3.5-fold) higher among those born to non-White mothers.

Conclusions: Childhood SARS-CoV-2 infection and COVID-19-associated illness are substantially underdiagnosed and underreported in the Amazon. Children in the most

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

socioeconomically vulnerable households are disproportionately affected by SARS-CoV-2 infection and disease.

Keyword: Food insecurity , Social Inequalities, COVID-19, SARS-CoV-2 infection, Amazon

Conflict of Interest Disclosure: None to declare.

Further Collaborators: This study was supported by the Brazilian National Council for Scientific and Technological Development (CNPq, grant numbers 407255/2013- 3, 303794/2021-6) and the São Paulo Research Foundation (FAPESP, grant number 2016/00270-6).The funders had no role in study design, data collection and interpretation.

PAB(T6)-76
Trans fatty acids and potential factors influencing their occurrence in plantain chips sold within the Accra Metropolis, Ghana

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Background and objectives: Despite conclusive evidence of the harmful effects of trans fatty acids (TFAs) on health, legislation regulating TFAs in foods remains voluntary in Ghana. There is scarce documented data on the concentration of TFAs in the national food supply and population consumption levels that could aid policymakers. Our pilot study assessed the TFAs content of a popular deep-fried snack as part of the effort to provide data on TFAs in Ghanaian foods. **Methods**: We used gas chromatography with a flame-ionizing detector (GC-FID) to determine the levels of 18-carbon TFAs (C18:1, C18:2 and C18:3) in plantain chips. One hundred and twenty plantain chips were collected from various processors and vendors in Accra. A questionnaire survey was also conducted to assess oil usage among commercial plantain chips processors. **Results**: Seven trans isomers of oleic acid (t9-C18:1), linoleic acid (LA), and alpha-linolenic acid (ALA) were detected in all samples: one of OA (t9-C18:1), two of LA (c9, t12-C18:2; t9, c12-C18:2), and four of ALA (c9, c12, t15-C18:3; c9, t12, t15-C18:3; c9, t12, c15-C18:3; t9, c12, c15-C18:3). TFA concentrations varied between samples, with the mean ranging from 1.4/100g fat to 2.9/100g fat and 0.4/100g food to 0.8/100g food. Trans isomers of LA (1.25g/100g fat and 0.34g/100g food) were the most significant contributors to total TFAs. The fat content ranged from 26.0g-30.9g. TFA levels were not always highest in samples with the highest fat content. Commercial processors' oil usage practices were generally poor. The vast majority (97%) admitted to reusing oils multiple times, with more than half of these processors reusing oils four or more times before discarding them. **Conclusion**: Plantain chips from various parts of Accra contain TFAs and a high amount of fat. Data on the use of oils by commercial processors suggest that the types of oils used for frying and the repeated use of oils are potential entry points for TFAs into this snack food. We recommend that plantain chips be consumed in moderation, and future efforts to eliminate TFAs from the national food supply should include public education campaigns on the proper selection and use of oils.

Keyword: trans fatty acids, Gas Chromatography, deep-frying, repetitive usage of cooking oils, plantain chips

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PAB(T6)-77
"Some are healthy some are not…" Accra-based food retailers' characterization of the healthiness of the food they sell.

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Background and objectives: Increasing the availability of healthy foods within food retail outlets can improve consumers' food environment. Such actions or inactions by food retailers may affect people's food purchasing behavior and consumption. This study explored Accra-based food retailers' perceptions and understanding of healthy food as well as the measures they adopt to encourage healthy food choices.

Methods: In-person semi-structured interviews were conducted with owners and managers of Accra-based supermarkets (n=7) and corner stores (n=13) in March 2021. The interviews were recorded, transcribed and coded in excel. We employed thematic analysis to analyze the transcripts.

Results: The retailers' understanding of healthy food is exemplified by such expressions as "health, absence of disease, longevity, balanced diet, diversity, sanitation, and certification" - describing what they sell as "therapeutic, healthy, balanced diet, certified, and or approved". A handful of retailers were neutral, or uncertain about the healthiness of what they sell. They evoked terms like "fitting consumer needs, innocent or generally good". Very few openly described what they sell as "junk" (high in sugar), high in salt, or risky (posing some health threats). Some of the retailers indicated that they advise against the overconsumption of such foods. Overall, retailers were not knowledgeable about the health impacts on health, of very salty, very sugary, and very fatty foods.

Conclusions: Retailers in Accra require interventions that improve their health, nutrition, and food literacy. Any efforts to introduce healthy food retail policies should be coupled with nutrition literacy interventions for key stakeholders such as food retailers.

Keyword: Food environments, Healthy foods, Unhealthy foods, Food retailers, Ghana

PAB(T6)-78
Interpreting compliance to the EAT-Lancet diet using dietary intakes of lactating mothers in rural Western Kenya

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Background and objectives: The EAT-Lancet reference diet aspires to be a "planetary healthy diet". We compared lactating mothers' diets to this diet, investigated associations between compliance and body mass index (BMI), and estimated costs of the mothers' diets.

Methods: We used single 24-hour dietary recall data from a cross-sectional survey nested within a cluster-randomized trial in Western Kenya (n=242). Mothers' intakes were compared to recommended intake ranges of 11 EAT-Lancet food groups, defining compliance (maximum score of 11) two ways: daily intake within the recommended ranges (including 0g as an acceptable intake for some food groups), or intake with a lower bound > 0g. Ordinal logistic regression models assessed associations between compliance and BMI. Cost of mothers' diets and hypothetical diets with intakes within recommended ranges were estimated using dietary data and food price survey data of two markets within the mothers' locality.

Results: Mean energy intake was 1,827 (95%CI: 1,731, 1,924) kcal/day. Relative to the reference diet, mothers' diets were on average higher for grains (63.5% of total energy vs. <60%); within recommended ranges for tubers (49.6g vs 0-100g) fish (61.7g vs. 0-100g), beef (16.8g vs. 0-28g), and dairy (165.2g vs. 0-500g); closer to the lower bounds for chicken (1.4g vs. 0-58g), eggs (5.0g vs. 0-25g), legumes (10.1g vs. 0-100g), and nuts (5.0g vs. 0-75g); and lower for fruits (25.0g vs. 100-300g) and vegetables (180.0g vs. 200-600g). Mean (95%CI) compliance scores were 8.2 (8.0, 8.3) when recommended ranges included 0g as acceptable and 1.7 (1.6, 1.9) otherwise. BMI ranged from 16.8-34.8 kg/m^2 and there were no significant associations between compliance and BMI. Mothers' diets and hypothetical diets within recommended ranges (with lower bounds >0g) averaged 184.6 KES (1.6 USD) and 357.5 KES (3.1 USD) per person daily, respectively.

Conclusions: Diets of lactating mothers in rural Western Kenya were not diverse and diverged from the EAT-Lancet reference diet when an intake of 0g was considered unacceptable for protein-rich food groups. Lower bound intakes of 0g are inappropriate when describing compliance to recommended diets in food-insecure populations. It would likely cost more than mothers currently spend to tailor their diets to the EAT-Lancet reference diet.

Keyword: EAT-Lancet reference diet, Lactating mothers' diet, Diet cost, Maternal body mass index

PAB(T6)-79
Nutrition practices and work environment affect the health of Canadian long-haul truck drivers

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Background and objectives: In Canada, the long-haul truck driver (LHTD) industry is the 2nd largest employer of males. However, the health of drivers is an immense concern with increased risks for non-communicable diseases (NCDs) which include obesity, type 2 diabetes, and cardiovascular associated diseases. These health risks may, in part, be responsible for a shortage of LHTD. Research in the relationship of demographics of the drivers, the working environment, and nutrition practices is lacking. We hypothesize that nutrition practices and work settings of LHTD associate with poorer health. The objective of this presentation is to examine the relationship between nutrition behavior and work conditions that can affect the perceived health of LTHD. **Methods**: Objective nutrition measures and surveys (i.e. nutrition behavior, working environment, truck driver demographics) were completed by 206 LHTD across 7 truck stops in the Provinces of Alberta and Saskatchewan, Canada. Objective nutrition/health measures included anthropometry, body composition by bioimpedance, and blood pressure (BP). body mass index (BMI), fat mass, and BP were used as proxies for health. These were then associated with nutrition practices and the work environment of LHTD. **Results**: Participants were 51.6±12.4 years of age and the majority male (96.5%). Most LHTD (>50%) were classified as overweight (BMI range 25-29.9) or obese (BMI >30) and their BPs were elevated above normal. Higher BMI was associated with poorer self-reported health ($p<0.05$) and higher BP ($p<0.05$). Increased body fat ($p<0 .001$) and lower muscle mass ($p<0.001$) were also related to health. Lower vegetable and fruit consumption ($p=0.05$) and increasing meal frequency ($p=0.07$) trended towards significance with higher BMI. More than half of the sample reported being sedentary or only taking part in light physical activity (54.5%). Sedentary/low activity approached significance ($p=0.06$) with poorer reported health being related to less activity. **Conclusions**: Less desirable nutrition behavior, activity patterns, and the work setting of LHTD are indicative of poorer perceived health that relate to higher rates of overweight and obesity and increased BP. Lifestyle and the food environment are contributing factors to drivers' health.

Keyword: Truck drivers, Obesity, Body Mass Index, Work environment, Nutrition practices

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-80
Predicting Overweight and Obesity Status among Malaysian Adults Using Supervised Machine Learning

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Background and objectives: One in two adults in Malaysia suffers from overweight or obesity (OW/OB), which is a primary health concern that significantly impact non-communicable disease burdens and threatens the national productivity and economic growth. Given the large complexity of obesity etiology, machine learning algorithms offer a novel approach in disentangling interdependent factors for OW/OB prediction. This study proposes a machine learning model that predicts OW/OB among working adults in Malaysia based on multi-domain data collected in the Malaysia's Healthiest Workplace by AIA Vitality 2019 survey.

Methods: Using data of 16,860 participants (mean age 34.2 ± 9.0 years, 41% males), predictor variables comprising sociodemographic, job characteristics, health and weight perception and lifestyle-related factors were selected, one-hot encoded and normalised. After a 70:30 train-test data split, the training set was trained using the Extreme Grading Boosting (XGBoost) algorithm with 10-fold cross validation repeated three times to predict OW/OB based on body mass index cut-off of 25. The predictive performance of the trained model in predicting OW/OB in the test set was evaluated using Area under the Receiver Operating Characteristic curve (AUC). Comparison was also done for predictive models built on data stratified by sex.

Results: The prevalence of OW/OB was 41.8% in this sample. Weight satisfaction, ethnicity, age and sex were the top OW/OB predictor variables for the overall model. The AUC were 0.81 (95%CI: 0.80, 0.82) for the overall OW/OB model. The predictive performance of the male model (AUC 0.78, 95%CI: 0.76, 0.80) was similar to that of the female model (AUC: 0.81, 95%CI: 0.80, 0.82).

Conclusions: This study produced predictive models with machine learning that are able to identify OW/OB with moderate-to-high accuracy. Our findings suggested that weight satisfaction, along with ethnicity, age and sex, are important predictors of obesity among working adults in Malaysia.

Keyword: obesity, overweight, prediction, machine learning, weight satisfaction

PAB(T6)-81
Evaluation of body dissatisfaction using our developed Japanese version of Body Image Scale among healthy Japanese adults

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Background and objectives: Body dissatisfaction can lead people to engage in unhealthy behaviors, such as unnecessary weight control or under eating. It has been reported more frequently among women though, body dissatisfaction among men and gender differences have not been well understood. We therefore aimed to examine Japanese men and women of wide range of ages using our newly developed Japanese version of Body Image Scale (J-BIS) (Yumen et al. 2021).

Methods: The subjects were 438 Japanese men and 698 Japanese women aged 20-75 who responded to a web-based questionnaire form (age, gender, height, weight, and body image) in 2020. Body image was examined using the J-BIS, which contains 10-point pictures from thin (score 1) to obese (score 10) for men and women, respectively. Subjects responded to both the picture closest to their current body image (CBI) and the picture closest to their ideal body image (IBI); the difference between CBI and IBI was quantified as body dissatisfaction, and compared between men and women.

Results: The BMI score for men was 23.9 ± 3.8 kg/m^2 (mean ± SD), and the prevalence of underweight (BMI < 18.5 kg/m^2) and overweight (25 kg/m^2 ≦) was 3.2% and 29.5%, respectively. On the other hand, the BMI score for women was 21.1 ± 2.9 kg/m^2, and the prevalence of underweight and overweight was 15.6% and 9.2%, respectively. The body dissatisfaction score was -1.4 ± 1.9 for men and -1.5 ± 1.7 for women with no significant by gender (p = 0.780). Of overweight men, 95.3% wished to become thinner. Of underweight women, 29.4% wished to become thinner and 21.1% wished to remain the same.

Conclusions: The results suggest that Japanese men and women have the same level of dissatisfaction with their body shape (desire to be a little thinner), although the percentages of underweight and overweight remarkable differ between the two groups. However, women, even if they were underweight, desired to be even thinner. To prevent unhealthy eating behavior and weight control, nutrition education is required for both men and women with normal weight or thinness to avoid unnecessary body dissatisfaction.

Keyword: body dissatisfaction, body image, body image scale, gender difference, thinness

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-82

Impact of the COVID-19 pandemic on mother's experiences during pregnancy, breastfeeding practices, and supporting environment for infants: A comparison between mothers delivered before and after the State of Emergency

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Background and objectives: The COVID-19 pandemic is making a considerable impact to the society and medical sites. Risk of infection might have increased anxiety among pregnant mothers and also reduced social support during early stage of raising infants. In the present study, differences in experiences during pregnancy, breastfeeding practices, and perceived support from surroundings were investigated among mothers who had childbirth in Japan using the State of Emergency (SoE) as a turning point of the COVID-19 pandemic in Japan.

Method: An online questionnaire survey was conducted on mothers met inclusion criteria of 1) 18 years and above at the time of delivery, 2) gave birth in Japan, and 3) have a child under 24 months. The questionnaire included items on socio-demographics as well as experiences during pregnancy, breastfeeding practices, and support on breastfeeding and infants. Participants were informed about the background of the study and provided a consent prior to their participation to the study. All analysis was conducted using the SPSS package (version 27, Tokyo, Japan) and a significance level of 5% was used.

Results: Of 1,022 responses, 994 responses were considered eligible for analysis and divided into Pre-SoE (n = 426) and Post-SoE (n = 568) based on the timing of childbirth. The Post-SoE experienced a greater concern to visit hospital during pregnancy (86.0% vs 29.1%, p<0.01) and had no attendees except medical staff at delivery compared with their Pre-SoE counterparts (69.4% vs 34.9%, p<0.01). No group differences in breastfeeding practices were observed and more than 85% of mothers who selected exclusive breastfeeding at three months continued at six months. The Post-SoE mothers perceived that they did not receive sufficient education on breastfeeding practices at hospitals (12.2% vs 8.0%, p<0.05) and insufficient support on breastfeeding from family and friends (72.9% vs 60.6%, p<0.01). Overall, the Post-SoE mothers felt that they had insufficient support from surroundings to their infants (47.1% vs 37.8%, p<0.01).

Conclusion: The COVID-19 pandemic did not influence a method of breastfeeding. However, mothers who had childbirth after the SoE experienced a greater concern during pregnancy and also perceived less support from surroundings on breastfeeding and infants.

Keyword: The COVID-19 pandemic, The State of Emergency, Breastfeeding, Social support, Japan

Conflict of Interest Disclosure: None.

PAB(T6)-83

Breakfast for students at primary schools in Bangkok, Thailand: Opportunities and potential impacts on meal quality based on Thai nutrient-profiling

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Background and objective: The benefits of breakfast, the first meal of the day, as part of a healthy and balanced lifestyle, are widely known from a nutritional, psychological, and societal point of view. The breakfast meal is related to several critical health factors that include healthy body weight, especially among children. The objective was to assess the adequacy of Thai breakfast for children available at schools in Bangkok, applying nutrient-profiling criteria and Thai Dietary Reference Intakes (Thai DRIs).

Methods: Twenty popular menus for breakfast at primary schools in Bangkok were collected. Most menus normally were single dishes and easy to eat. We determined serving sizes for two levels; small and medium sizes for kindergarten and students (grade 1-6), respectively. The nutritive values of all menus were calculated by the Thai food composition software (INMUCAL-Nutrients V.4.0). The nutrient-profiling criteria were used to grade quality of breakfast as follows; grade A (score >16), 'grade B' (12-16), and 'grade C' (score <12). The grading of menus was developed scenarios for breakfast patterns per week. The goal of breakfast is 20% of the total day, based on Thai DRIs.

Results: One menu was passed the 'grade A', while 6 and 13 menus were accepted as 'B' and 'C', respectively. The exceeding sodium was concerning for some menus based on nutrient-profiling criteria. The total scenarios of breakfast for 5-day a week were 5,292 patterns, which all reached 20% of the DRIs, including a variety of menus per week, and passing nutrient-profiling criteria. Among 5,292 patterns, 8 patterns (0.15%), 4,335 patterns (81.92%), and 949 patterns (17.93%) passed grade A, B, and C, respectively. When we added at least one serving size of fruit, the dietary fiber and some vitamins were improved.

Conclusion: The nutrient-profiling is a helpful tool to use in conjunction with interventions aimed at improving diets. It can also be used in implementing the recommendations on the breakfast to children. This study also provided a general picture of children's breakfast in Bangkok, mainly focusing on reducing sodium, salt and increasing dietary fiber, fruits and vegetables offering healthier meals.

Keyword: Breakfast, Thai nutrient-profiling criteria, Primary schools, Thailand

PAB(T6)-84

Association between barley intake and blood pressure and HbA1c in a real-life setting: A longitudinal observational study among male workers in Japan

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Background and objectives: β-glucan, the primary dietary fiber in barley, has been reported to have various health benefits. In a previous study, we reported an inverse association between the cumulative number of intake times of rice with barley in the 12 weeks before the follow-up and systolic blood pressure and HbA1c in a workplace cafeteria. The purpose of this longitudinal observational study was to examine if the frequency of rice with barley consumption by workers is inversely associated with changes in their systolic blood pressure and hemoglobin A1c (HbA1c) in their workplace cafeteria where information on the functional properties of barley was displayed on the tabletop pops and workers were allowed to freely choose rice with barley.

Methods: The study subjects were male workers (n = 890). The number of bowls of rice with barley consumed was assessed through an electronic purchase system using an integrated circuit (IC) - chip with menu information - equipped tableware and personal identification cards in the cafeteria. Outcomes were based on data from annual health examinations. Multiple linear regression analysis was performed using the change in systolic blood pressure and HbA1c measurements as the objective variable and the average weekly intake of rice with barley consumed during the 12 weeks before the follow-up health checkup as the explanatory variable.

Results: After adjusting for age, body mass index, alcohol use, smoking, exercise, total energy intake, medication for hyperlipidemia, and intakes of soy products and green tea as confounders, there was a significant inverse association between systolic blood pressure and intake of rice with barley, 2.0-3.9 times a week (β= -9.14, $p < 0.05$). On the other hand, a marginal inverse association was found between HbA1c and when rice with barley was consumed 1.0-1.9 a week (β= -0.13, $p = 0.06$).

Conclusions: Serving rice with barley, providing information on barley's functional properties, and allowing employees to consume of their own free will in a workplace cafeteria may promote the benefits of barley on systolic blood pressure and HbA1c.

Keyword: Barley, HbA1c, Systolic blood pressure, Food environment, Employee cafeteria

Conflict of Interest Disclosure: The authors received research funding from the company of the study target.

Further Collaborators: Yuji Nagasaka, Naoki Takeda, and Kunio Matsui (Employees of Toyota Motor Corporation, the company that was the target of the study).

PAB(T6)-85

Health and economic impacts of dietary salt reduction policies in Japan, 2019–2028: a Markov model simulation analysis

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Background and objectives: Reducing dietary salt intake is an important population strategy for prevention of cardiovascular diseases (CVD). Evidence from health economic evaluation is useful for policymakers to determine how to allocate limited resources among nutrition programs. We aimed to evaluate economic impacts of salt-reduction policies in Japan over 10 years. **Methods**: We assessed costs and benefits of four salt-reduction policies examined in a previous study in England: a national media campaign (Policy A), voluntary reformulation of processed food by the food industry (Policy B), mandatory reformulation (Policy C), and front-of-pack traffic light labelling (Policy D). We constructed a Markov cohort simulation model of the Japanese population over the period 2019 to 2028. The model consisted of four health states: well, acute CVD, chronic CVD, and dead. We adopted the health sector's perspective and a 2% discount rate. We used epidemiological data in Japan obtained from national surveys and a global database, and estimates from previous meta-analyses on the changes in CVD incidence and mortality associated with salt reduction. We applied a costing method and estimates on effectiveness of policies on salt intake from the previous study in England. We defined benefits as a decrease in national medical costs associated with CVD and costs as the sum of monitoring costs and policy costs. We calculated net benefits by subtracting costs from benefits to compare among policies. We conducted one-way sensitivity analyses to examine potential impacts of uncertainties. **Results**: The net benefit accumulated over 10 years was largest for Policy C at US$95.1 billion (cost: US$11.8 billion, benefit: US$106.9 billion), followed by Policy B at US$83.9 billion (cost: US$48.3 million, benefit: US$84.4 billion), Policy D at US$11.4 billion (cost: US$90.7 million, benefit: US$12.3 billion), and Policy A at US$11.2 billion (cost: US$109.5 million, benefit: US$12.3 billion). These estimates were sensitive to the effects of policies on salt reduction. **Conclusions**: According to the net benefits, all the salt reduction policies were likely to be worthwhile the investment in Japan. The mandatory reformulation was preferred to other three alternatives, but budget constraints should be carefully considered in decision-making.

Keyword: salt intake, nutrition policy, cardiovascular disease, simulation, economic evaluation

PAB(T6)-86

The association between dietary habits and the estimated 24-hour urinary salt excretion and sodium-to-potassium ratio in 3-yr old children

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Background and objectives: In this study we examined the association between dietary habits and the estimated 24-hour urinary salt excretion as well as the urinary sodium-to-potassium (Na/K) ratio in 3-yr old children.

Methods: The participants were 639 3-yr old children who underwent a health checkup in two cities and two towns in Kyoto Prefecture from January to November 2019. The urinary salt and Na/K ratios were obtained from the participants' first-voided urine in the morning. In addition, a questionnaire was employed to assess the dietary habits, etc., of the participants. Administered by the guardians of the children, the questionnaire included 5 items related to physical characteristics, 10 items on food intake frequencies and the awareness of the necessity to restrict salt intake for the children. The medians of the urinary salt and Na/K ratios among the higher intake and lower intake groups were examined using Mann–Whitney U test.

Results: Dietary habits and urinalysis were confirmed for 294 children. The median urinary salt (g/day) observed was 2.6 (25%tile, 75%tile, 1.7, 3.4), and median urinary Na/K ratio (mEq/mEq) was 2.6 (25%tile, 75%tile, 1.6, 4.1). The urinary Na/K ratios were significantly higher for the group that consumed a higher percentage of processed meat intake, showing a median of 2.9 (1.9, 4.7), compared with the lower group, median of 2.5 (1.5, 3.8), and the lower vegetable intake group, median of 3.1 (1.9, 4.9), compared to the higher intake group, median of 2.5 (1.6, 3.8) . There were no significant associations between the urinary salt values and the food intake or the mother's awareness of the necessity to restrict salt intake.

Conclusions: Significant associations were found between the processed meat intake and the vegetable intake and the urinary Na/K ratio in the 3-yr old children. Along with an appropriate education program, in the future these findings may aid in preventing cardiovascular diseases in the local community.

Keyword: Estimated 24-hour urinary salt excretion, urinary sodium-to-potassium ratio, dietary habits, 3-yr old children, health checkup

Conflict of Interest Disclosure: This study supported by JSPS KAKENHI Grant Number JP 15K00830

PAB(T6)-87

Understanding the environmental impacts of ultra-processed foods: insights from group model building with food system experts

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Background and objectives: The global food system is a leading driver of global environmental change due to significant use of resources (e.g. land and water), and production of pollutants (e.g. greenhouse gases). Finite environmental resources are being used to produce ultra-processed foods (UPFs). While a growing evidence base demonstrates UPFs are harmful to human health, much less is known about the environmental impacts. This study aims to develop and validate a model of the environmental impacts of UPFs. In doing so, this study a) better conceptualises the relationships between environmental sustainability and UPF production throughout each stage of production; b) identifies relationships between environmental issues to create a dynamic conceptual systems model; and c) differentiates the impacts of UPFs from less-processed foods.

Methods: Group-model building (GMB) is a system dynamics approach that allows a group of people to develop a shared understanding of how complex systems operate and can be used to test systems diagrams. A conceptual diagram displaying the known environmental impacts of UPFs, developed in a recent review, was converted into a causal loop diagram (CLD) by conducting an unstructured scoping review of scientific papers and reports to identify the relationships between variables. The CLD was subsequently expanded and tested for validity with food system experts using GMB.

Results: The final conceptual model illustrating the environmental impacts will be presented. The model is divided into 7 subsystems: 3 exploring the drivers of UPF production (social, biological and political economy drivers) and 4 exploring the environmental impacts of UPFs (impacts on climate, land, water and aquatic ecosystems, and waste). The model highlights the complex bi-directional relationships between UPF production and the natural environment. The model can be used to a) identify key parameters in quantitative analyses of the environmental impact of diets; b) provide a food-systems context for interpreting findings of quantitative analyses, particularly in relation to UPFs.

Conclusions: The relationship between UPF production and environmental degradation is complex and dynamic. This research can be used to guide future studies quantifying and understanding the environmental impact of diets and system-based policies for a healthier and more sustainable food system.

Keyword: Sustainability, Food systems, Environmental impact of foods, Ultra-processed foods, Group model building

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-88
Monitoring and compliance of salt reduction targets in processed foods in South Africa

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Background and objectives: Great strides in reducing salt intake have been made globally. In 2016, the South African Government implemented regulations to enforce mandatory reduction in the sodium content of a wide range of processed foods. A stepwise approach was adopted (target dates June 2016 and April 2020) to allow the food industry to achieve the final recommended sodium levels. Some reports of food labelling indicate compliance with targets, but in the absence of routinely collected laboratory analytical data, these cannot be validated.

Methods: The sodium content of key foods in 8 of 13 of the food categories included in the mandatory sodium reduction legislation were sampled and analysed using dry-ashing and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Calibration was done using an acidified calibration range. The analytical values were compared with sodium content information provided on food packaging labels.

Results: More than 80% of the foods analysed have sodium levels below the Phase 2 salt targets. For the categories of dry soup powders, fat and butter spreads, processed meat (cured), stock cubes/powders/ granules/emulsions/pastes or jellies, food labels had higher sodium content compared to the analytical values. The only food category that had a labelling value that was less than the analytical value for sodium was processed meats (uncured).

Conclusions: There is evidence that salt reduction regulations are effective in reducing population-level salt intake. However, this requires strong governmental leadership with multi-stakeholder buy-in. A key component to demonstrating the success of the sodium reduction legislation is systematic monitoring and surveillance of the sodium content of packaged foods, however there is no system in place for this to occur.

Keyword: sodium, salt reduction regulations, processed food

PAB(T6)-89
Developing preconception Multiple Micronutrients Supplementation (MMS) program for stunting reduction acceleration: Lesson learn from 5 districts in Indonesia

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Background and objectives: Indonesian Government targeting the reduction of stunting prevalence about 14% in 2024. Intervention of multi micronutrients supplementation (MMS) beginning at preconception period might become an effective strategy on reducing stunting prevalence. This study aims to pilot an MMS intervention during pre-conception periods to accelerate the reduction of stunting prevalence. **Methods**: An implementation research was conducted gradually in 5 districts. Initially, in 2010 we developed the integrated pre-marriage services in one district in East Java, as pilot project, in which the MMS for pre-conception and pregnant women was included. MMS from UNIMMAP formulation was used in this service. The new model was implemented in 9 subdistricts, until 2014. Year 2017, the model was adopted by other Districts Government, piloting in two subdistrict areas until 2018. In last 2019, we strengthen two Districts Government to implement the pre-marriage services system with the main intervention of MMS for total coverage of the brides to be and continued during pregnancy. Year 2020, we scale up the implementation in three districts areas (South Kalimantan, North Maluku, Madura Island).

Results: The implementation of pre-conception MMS program in 5 districts had wide variation depend on the local government commitment and supply of MMS. MMS supply for this intervention was attained form The Vitamin Angels Alliance. The mechanism of services involved multi sectoral begin at village level, subdistrict public health center (PHC), and subdistrict Religious Affair Office (RAO). The MMS was distributed in Public Health Center. The bride to be attended Village office to receive marriage registration form, then attended PHC to receive health services and MMS, finally registered in RAO. During 3 years (2018-2021), there is significant reduction of stunting prevalence in 5 districts: in Probolinggo from 49% to 23.3%, In Sidoarjo reduce form 27%-14.8%, in Sampang Madura form 47% to 17%, in Barito Kuala from 34,12% to 32.4%, in West Halmahera from 30,8% to 30%.

Conclusions: The MMS program begin at pre-conception with the target of brides to be may have significant contribution on stunting reduction strategy in 5 districts, but it need more information about the contribution of other programs

Keyword: multiple micro nutrients, preconception, stunting

Conflict of Interest Disclosure: We declare that no conflict of interest with other parties

Further Collaborators: The Vitamin Angels Alliance, USA

PAB(T6)-90

Association between soy products intake and low-density lipoprotein cholesterol in a real-life setting: A longitudinal observational study among male workers in Japan

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Background and objectives: Soy protein has beneficial effects on serum lipids. In a previous study, we reported that the cumulative number of intake times of soy products in the 12 weeks before the follow-up was inversely associated with low-density lipoprotein (LDL) cholesterol levels among workers in a workplace cafeteria. The workers had a free choice of soy products, and tabletop pops displayed the functional properties of soy protein. To further add to this research, the present study investigated the association between the frequency of soy products intake and LDL cholesterol levels among these workers.

Methods: The number of soy products consumed by 890 male workers was assessed through an electronic purchase system using an integrated circuit (IC) - chip with menu information - equipped tableware and personal identification cards in their workplace cafeteria. The workers had a free choice of soy products, and tabletop pops displayed the functional properties of soy protein. Outcomes were based on data from annual health examinations. Multiple linear regression analysis was performed; the response variable was the change in LDL cholesterol levels while the explanatory variable was the average weekly intake of soy products within the 12 weeks before the follow-up health checkup.

Results: In a model adjusted for age, body mass index, alcohol use, smoking, exercise, total energy intake, medication for hyperlipidemia, and intake of rice with barley and green tea as confounding factors, significant inverse associations were found between LDL cholesterol levels and soy products intake, 1.0-1.9 times a week (β= -7.16, $p < 0.05$), 2.0-2.9 times a week (β= -9.50, $p < 0.05$), and 3.0-3.9 times a week (β= -12.23, $p < 0.05$). The association was slightly attenuated by further adjustment with the baseline value of LDL cholesterol.

Conclusions: In a workplace cafeteria with soy products and available information on their functional properties, the consumption of soy products of the employees' own free will may benefit LDL cholesterol levels.

Keyword: Soybeans, LDL cholesterol, Food environment, Employee cafeteria, Objective assessment

Conflict of Interest Disclosure: The authors received research funding from the company of the study target.

Further Collaborators: Yuji Nagasaka, Naoki Takeda, and Kunio Matsui (Employees of Toyota Motor Corporation, the company that was the target of the study).

PAB(T6)-91

Geographical variation in the consumption of dairy products in adults in China: preliminary results from a systematic review

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Background and Objective: Dairy intakes are known to vary according to geographical regions, age and sex amongst others. Research on the variation in the consumption of dairy foods in China is lacking, specifically the influence of geographical location. To fully understand factors influencing the differences in dairy consumption among people living in China, a systematic review was conducted. Studies reporting dairy intakes according to classifications of geographic location were summarized in the present review.

Methods: Web of Science, Embase, and PubMed databases were searched for studies published between January 2000 to October 2021. The following search terms were used: Dairy OR Milk OR Cheese OR Yogurt OR Yoghurt OR Yoghourt OR Butter OR Cream OR Milk powder OR Food AND Intake OR Consumption OR Market OR Diet OR Dietary AND China OR Chinese OR Asian. The search was limited to studies carried out in human adults (≧18 years), written in English or Chinese languages. Papers reporting dietary intakes of dairy consumption across geographical location sub-groups were considered for inclusion in this review.

Results: 11 studies reported dairy consumption across different location-specific cohorts in China. Different regions reported in studies were classified as urban v rural; North v South, coastal v inland; East, West and Central, as well as by the size of city or country region. Papers examining dairy consumption between urban and rural areas, reported higher intakes of dairy products in urban populations compared to those living in rural areas. Coastal, Northern and Eastern residents consumed more dairy products than those living in other regions in China, and people in larger cities had higher reported intakes than smaller cities.

Conclusions: Population sub-groups in varied geographic locations across China displayed significant differences in the amount of dairy consumed. Information on dairy intake across different regions in China may help to understand variations in dairy consumption and could aid targeted strategies to enhance intakes in areas of nutrient inadequacy.

The work described herein was supported by the China Scholarship Council (CSC) and Food for Health Ireland (FHI), from Enterprise Ireland under Grant No. TC20180025.

Keyword: Dairy consumption, China, Geographical location

Conflict of Interest Disclosure: FHI receives financial support from members of the Irish dairy industry.

PAB(T6)-92
Humanitarian impact of climate change on nutrition security in low-income countries and conflict zones

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Background and Objectives: Over the last several decades, natural disasters such as droughts and floods triggered by the climate change are fast becoming a threat for the already vulnerable population living in places which lack access to health care. The climate crisis not only negatively impacts the quantity and quality of the food, but may cause high inflation which aggravates local conflict and results in severe food insecurity in many countries. Médecins Sans Frontières (MSF) is a non-governmental humanitarian medical organization founded in 1971, operating in over 80 countries and providing free health care to the people affected by conflict, epidemics, or disasters. In 2020, MSF globally treated 161,400 severely malnourished children including 64,300 hospitalizations for severe acute malnutrition (SAM). We assessed the impact of these climate-induced disasters on undernutrition among the children under 5 years-old in neglected, fragile, conflict-affected settings.

Method: The data was collected from MSF nutrition surveillance and clinical databases in MSF intervention areas where significant climate change has been reported. Nutritional screening was done by mid-upper arm circumference (MUAC).

Results: In Somalia, long term insecurity and conflict, exacerbated by frequent floods and droughts combined with desert locust swarms aggravated the food insecurity. In February 2022, among 81,706 children screened by MSF team in Baidoa area (South West of Somalia), 16.6% of the children were acutely malnourished of which 3.4% severe. In response to the consequences of the drought, MSF scaled up emergency nutrition support to five regions in Somalia. In 2021, Madagascar faced worst drought in 30 years, causing 740,000 children fall into acute malnutrition of which 120,000 were SAM cases this number was 80% higher than that of 2020. In Amboasary district in Anosy region (a fragile region in Southern Madagascar), 28% of the children were malnourished, one-third of them were SAM. MSF set up more than 15 mobile clinic sites in this region for malnutrition screening and treatment.

Conclusions: Climate change, exacerbated by conflict caused a serious nutrition crisis among children, demanding an urgent humanitarian response.

Keyword: climate change, nutrition security, conflict zone

PAB(T6)-93
A survey of the most memorable tasks or turning points performed by dietitians working in Japanese local governments

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Background and objectives: The number of dietitians implementing dietary projects per local government is limited. Therefore, dietitians should strive to increase their self-efficacy. Self-efficacy is based on four major sources of information: performance accomplishment, vicarious experience, verbal persuasion, and emotional arousal. In this study, we aimed to identify tasks that improved the self-efficacy of municipal dietitians by assessing their routine dietary projects.

Methods: We conducted a web survey of dietitians working in Japanese local governments from January to March 2021. We asked them to describe their most memorable tasks or turning points. The tasks were defined as a successful experience and were categorized based on the basic guidelines for health promotion and improvement of nutrition and dietary habits by the administrative dietitians in the community.

Results: We received responses from 452, 323, and 1031 dietitians working in prefectures, cities with public health centers or special wards, and municipalities, respectively. The top five tasks that impressed dietitians in prefectures were establishing systems with related departments and securing human resources; establishing joint systems with municipalities; collecting and organizing municipal health checkups; collecting, organizing, and analyzing various surveys; and planning, goal setting, and evaluating. Most of the top five tasks were similar for dietitians in municipalities and cities with public health centers and special wards, including establishing nutrition education promotion network; implementing, evaluating, and improving nutritional education leading to behavior change; analyzing and clarifying challenges, planning, goal setting, and implementing nutritional education based on specific health checkups and guidance; and health promotion activity for children. However, dietitians from municipalities worked on the health promotion activity for older adults, and dietitians from the cities worked on guiding, supporting, and evaluating specific foodservice facilities. Approximately 17%-20% of the dietitians had no memorable tasks.

Conclusion: The most impressive tasks for dietitians working in Japanese local governments, regardless of their working site, were multidisciplinary cooperation and implementation of projects planned by themselves. being involved in these tasks could improve the self-efficacy of dietitians working in Japanese local governments.

Keyword: dietitians working in local governments, dietary projects, self-efficacy, successful experience

PAB(T6)-94
Dietary habits associated with dental caries in Japanese elementary school children: a cross-sectional study

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Background and objectives: Dental caries is multifactorial-induced infectious disease and a major oral health problem in children. We examined the association between dietary habits and dental caries in Japanese elementary school children.

Methods: A cross-sectional study was conducted with 2457 first to sixth grade students from seven public elementary schools and their guardians residing in Saga, Japan. Dietary habits were measured using anonymous self-reporting questionnaires. The questionnaire contained basic items about the participants' living environment, lifestyle habits, and typical dietary menu (breakfast, dinner, snacks). Final data analysis was performed on a total of 2412 children. All statistical analyses were performed using JMP® 14 (SAS Institute Inc., Cary, NC, USA). All reported *P* values were two-tailed, and $P < 0.05$ was regarded as statistically significant.

Results: Compared with school children without cavities (n = 721), those with cavities (n = 1691) tended not to eat a variety of food items for breakfast and dinner ($p < 0.05$), tended not to eat green and yellow vegetables and other vegetables for breakfast and dinner ($p< 0.05$), tended to eat a snack before breakfast ($p = 0.01$) and after dinner ($p < 0.0001$), tended not to have breakfast every day ($p = 0.0006$), and tended to have a higher frequency of eating instant foods ($p < 0.0001$).

Conclusions: These results suggest that school children with dental caries tend to have unhealthy dietary habits such as a lower intake of vegetables and a higher intake of snacks and instant foods compared with those without dental caries.

Keyword: dietary habits, dental caries, Japanese children, a cross-sectional study

PAB(T6)-95
Are Front-of-Pack nutritional labels effective in improving food choices of consumers and nutritional quality of food products? A narrative review

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Context: Front-of-Pack nutrition labels (FOPNL) are increasingly being used globally with the goal of driving healthier consumer food choices and incentivizing food manufacturers to improve their products. This critical review of the relevant scientific literature was conducted to determine the effectiveness of FOPNLs against the desired outcomes/goals.

Methods: Four FOPNL (Multiple Traffic Lights, Warning Signs, Nutri-Score, Health Star Rating) were evaluated for their impact on consumers' food purchase or selection (FPS), consumption habits (CH) and on product reformulation (PF) .) Studies were searched with appropriate keywords, included when original and examining the relevant FOPNL and outcomes, and analyzed in detail.

Results: Research studies were identified addressing FPS (31 studies), CH (6) and PF (7). FOPNL, overall, appear to have a beneficial effect on the healthiness of FPS, but this effect is of very small magnitude in empirical studies and only slightly higher in experimental studies, highlighting the importance of study design. Very few data exist on FPS in populations of public health interest, especially in low-income consumers. Regarding CH, scarcity of data did not allow conclusions. A few favorable changes were observed in the nutrient composition of foods after implementation of FOPNL, however concerning only nutrients included in the nutrient profiling system underlying the FOPNL (sugars primarily). Product reformulation to reduce nutrients to limit may have unintended consequences such as more complex processing and/or ingredient use. **Conclusion**: The four FOPNL seem to have small but measurable effects on guiding consumers towards healthier dietary choices. However, their implementation may have unintended and potentially unfavorable consequences such as decrease in intakes of nutrients not targeted by the FOPNL systems. Some favorable trends were observed on the nutritional quality of the food supply, although the voluntary and recent implementation of FOPNLs prevents reliable conclusions. The heterogeneity of designs associated to the inconsistencies of findings hinder any ranking between the four FOPNLs of interest and no single FOPNL ideally addressed all outcomes. Further and higher quality research is needed to confirm the real effects of these four FOPNLs, their magnitude and their maintenance over the time on both food demand and supply.

Keyword: labeling, consumer behavior, nutritional reformulation, nutrient profiles, nutrition policy

Conflict of Interest Disclosure: Authors benefited from fees from General Mills for this work.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-96
Latent Class Analysis to identify and describe dietary patterns of women in Ibadan, Nigeria.

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Background and objectives: Latent class analysis is a method to identify and characterize unmeasured classes of women based on their dietary patterns (DP). Women within the same latent class are relatively homogeneous regarding their food group (FG) intake patterns. We used latent class analysis to characterize distinctive DP among urban Nigerian women; and to assess the relationship between these DP and nutritional status.

Methods: We used 24h-recalls to assess dietary intakes in 225 women aged 18-49 years from Ibadan, Nigeria, complemented with anthropometric measurements. Foods consumed were classified into the 10 FG as defined for the Minimum Diversity Score for Women. For each FG, intake was categorized as 'negligible' (<15g), 'low' and 'high' (>=15g) by median split, and used as input variables for latent class analysis (Latent Gold vs 6.0). The number of DP was determined using Bayesian and Akaike Information Criteria, and likelihood ratio tests. DP were described by the conditional probabilities of intake category for each FG. To investigate the relationship between DP and body mass index, we used logistic regression.

Results: Three patterns (DP1-3) were identified, with DP1 (prevalence: 57%) characterized by high consumption of meat and fish and other vegetables, low/negligible consumption of leafy vegetables, and nuts and seeds; DP2 (31%) with low or negligible quantities of all FG, mainly fruits and vegetables; and DP3(12%), with high consumption of starchy foods, pulses, meat and fish, leafy and other vegetables. All DP presented negligible intake of dairy, eggs, vitamin-A rich fruits and vegetables and other fruits. The difference between DP was explained by leafy vegetables, other vegetables and meat and fish FG. Compared to DP1, the odds of being underweight increased by 51% in DP2, and decreased by 38% in DP3; the odds of being obese increased by 17% in DP2, and 35% in DP3.

Conclusions: Three DP were identified in the studied Nigerian women and they mainly differ in consumption of vegetables and animal protein rich foods. The application of latent class analysis can contribute to the identification of groups with specific consumption patterns and needs in order to inform appropriate and tailored interventions to combat all forms of malnutrition.

Keyword: Dietary patterns, Latent Class Analysis, Nigeria

PAB(T6)-97
Transforming food waste into functional ingredients: Lessons from a Dutch case study

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Background and objectives:
Several million tonnes of nutritionally dense by-products such as peels and trimmings of fruits and vegetables end up in landfills every year. Through technological innovation, it is possible to upcycle at least a part of this waste into ingredients that can be used to improve or fortify existing food products. However, for this kind of valorisation to be commercially feasible, entrepreneurs must overcome several legislative and logistical barriers. Through this case study, we present the example of a Netherlands-based start-up that has been able to successfully transform fruit peels into valuable products such as additives, oils, and functional fibre. By critically examining the barriers and drivers of such a business, the study contributes to a deeper understanding of the intersection of the circular bioeconomy and functional ingredients derived from food waste.

Methods:The study uses a qualitative case study approach wherein a real-life bounded system is investigated by drawing from multiple sources of information. We investigate data generated through in-depth unstructured interviews, field observations, and analyses of documents and digital material.

Results: Our results indicate that factors such as funding opportunities, legislative flexibility, ability to exercise intellectual property rights, and community support play a critical role in valorising food waste as functional food ingredients.

Conclusions:A circular bioeconomy where food waste can be transformed into nutritionally valuable food ingredients is feasible only through multi-stakeholder cooperation. Next to financial and technological resources, setting up such operations requires support from policy makers, legislators, and various supply chain actors.

Keyword: circular economy, functional foods, bioactive compounds, food waste, case study

Conflict of Interest Disclosure: The authors hereby declare that there are no conflicts of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-98
Comparing health insurance data and survey data in estimating prevalence of chronic diseases

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Background and objectives: As part of the development of a life course microsimulation model that aims to understand the relationship of diet to non-communicable diseases (NCDs) and to estimate the burden of diet-related chronic conditions, it is of interest to compare population prevalence estimates of NCDs using national health surveys and administrative insurance records. This study specifically compares the agreement between the Belgian Health Interview Survey (BHIS) and the Belgian compulsory health insurance data (BCHI) in ascertaining chronic hypertension, hypercholesterolemia and diabetes in Belgium.

Methods: The most recent cycle of BHIS (2018) and BCHI records were linked through unique identifiers by Sciensano. BHIS provided the self-reported information on diabetes, hypertension, and hypercholesterolemia among a representative sample of Belgian adults. For BCHI, the chronic condition was attributed for every individual reviewing the medication prescription records identified using the ATC/DDD system. Chronic patients were defined as those individuals consuming a total of at least 90 DDD of chronic-indicated medication in a year. Disease prevalence, Cohen's kappa coefficient, sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) with BHIS as the reference standard were estimated and used to assess the agreement between both data sources.

Results: BHIS and BCHI identified 5.4% and 5.1% diabetes cases in 2018, respectively. For hypertension, BHIS has an estimated 15% cases while BCHI has 20%. Diabetes has kappa coefficient of 0.8, sensitivity of 78%, specificity of 99%, PPV of 83%, and NPV of 99%. Hypertension, on the other hand, has kappa coefficient of 0.6, sensitivity of 77%, specificity of 90%, PPV of 59%, and NPV of 96%. The results for hypercholesterolemia are currently being calculated.

Conclusion: BCHI underestimated and overestimated diabetes and hypertension prevalence, respectively. Moreover, the two data sources have a stronger agreement for diabetes prevalence than for the prevalence of the other NCDs.

Keyword: chronic disease, administrative data, health interview survey

PAB(T6)-99
Relationship between vegetable and fruit intake, their biomarkers and health indicators: Epidemiological literature review in Asians.

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Background and objectives: Accurate estimation of food intake is necessary to clarify the relationship between dietary intakes and particular health conditions, but self-reported assessments often results in estimation errors. Biomarkers of vegetable and fruit intake can be important tools to objectively estimate dietary intake in nutritional epidemiological studies. To establish the relationship between vegetable and fruit intake, their blood biomarkers, and health indicators, we conducted a systematic review of literature.

Methods: We searched peer-reviewed articles published on PubMed and CiNii Articles to create a search formula for vegetable and fruit intake, serum vitamin C and 5 carotenoid types (α-carotene, β-carotene, β-cryptoxanthin, lutein and lycopene) as biomarkers in Asians, and considered the relationship between vegetable and fruit intakes, their biomarkers and health indicators.

Results: Five articles, including 3 cross-sectional studies, 1 longitudinal study and 1 randomized controlled trial, were selected. The participants of the studies were local residents (3 articles), textile workers (1 article), and type 2 diabetics (1 article), and the number of participants varied from 27 to 7012. The methods applied in estimating vegetable and fruit intakes were Food Frequency Questionnaire (FFQ) – (5 cases), FFQ combined with 24-hour dietary recalls (1 case), FFQ combined with a dietary record (1 case). Four articles showed a significant positive correlation between the fruit and/or vegetable intake and the serum concentrations of α-carotene, β-carotene, β-cryptoxanthin, α-tocopherol, γ-tochopherol, and/or vitamin C. Threonic acid or proline betaine were reported as new biomarkers for vegetable or fruit intakes, respectively in 1 article. However, there was no article which examined the relationship between vegetable and fruit intakes, their biomarkers and health indicators.

Conclusion: Serum α-carotene, β-carotene, β-cryptoxanthin, α-tocopherol, γ-tochopherol, and/or vitamin C were proposed to be useful biomarkers for estimating vegetable and/or fruit intake in nutritional epidemiological studies. In the future, it will be necessary to accumulate evidence, including the quantitative relationship between vegetable and fruit intake and their biomarkers and the relationship between them and health indicators.

Keyword: biomarker, vegetable, fruit, carotenoids, literature review

Conflict of Interest Disclosure: The authors declare no conflicts of interest associated with this presentation.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-100

A qualitative exploration of the socio-psychological factors associated with young Australian adults' consumption of Energy Dense and Nutrient Poor (EDNP) foods

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Background and objectives: Young Australian adults exhibit the highest consumption of Energy Dense and Nutrient Poor (EDNP) foods (commonly referred to as discretionary foods), when compared to all age cohorts in Australia. This research aimed to explore the socio-psychological factors associated with young Australian adults' consumption of EDNP foods. The uniqueness of this study resides in its focus on EDNP foods, as most studies until now have focussed on identifying factors associated with healthy eating. While factors influencing the consumption of EDNP foods are yet to be fully explored and defined, this study addresses this important research gap. **Methods**: Using qualitative descriptive research methodology and based on the interpretivist approach, thirty-eight young adults were interviewed Australia-wide. Participants needed to be aged between 18 and 30 years, English speaking and residing in Australia. Interviews were conducted either online or over the phone. Data obtained from the semi-structured interviews were analysed using a thematic data analysis technique.

Results: Five themes were noted: (1) psychological factors, (2) social factors, (3) intrinsic qualities of EDNP foods, (4) accessibility and affordability and (5) health related beliefs. Firstly, motivation, perceived behaviour control (habits and self-restraint), impulsivity, craving and coping strategies were identified as the five psychological factors influencing participants' intake of EDNP foods. Secondly, social norms, peer pressure and social media were noted as key social factors. Third, taste, appeal and convenience were observed as intrinsic qualities driving participant's EDNP food intake. Fourth, accessibility and affordability determined participants' intake of EDNP foods. Lastly, perceptions concerning health and perceived consequences of consumption determined the young adults' intake of EDNP foods.

Conclusions: The key socio-psychological factors identified in this study impacted participants' consumption of EDNP foods in both positive and negative ways. This research is significant as it is one of the first studies that has qualitatively explored the socio-psychological factors associated with young Australian adults' consumption of EDNP foods. The findings may help guide future behaviour change interventions and public health programs aimed at ameliorating young adults' EDNP food behaviours

Keyword: Qualitative, Young Australian adults, Socio-psychological factors, Energy Dense and Nutrient Poor foods, Discretionary foods

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-101

Comparison of nutrient intake on weekdays and holidays and evaluation using the Dietary Reference Intake of infants attending nursery schools in Japan

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Background and objectives: The objective of this study was to clarify the current state of nutrient intake in Japanese infants attending nursery schools.

Methods: 798 infants attending nursery schools in Japan were targeted. In 2019 or 2020 a dietary survey was conducted on two nonconsecutive weekdays and two holidays from October to November. The nutrition calculation software Shokujisirabe was used to calculate the nutrient intake. SPSS 27 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. This study was approved by the research ethics committee of the relevant university and was conducted with the consent of the parents and the target facility.

Results: The average daily intake (standard deviation) of energy and major nutrients are presented in the order of energy, protein, lipid, carbohydrate, vitamin A, vitamin B_1, vitamin B_2, vitamin C, calcium, and iron. The intake on weekdays was 1,430 (229) kcal, 51.9 (9.9) g, 47.5 (11.5) g, 194.2 (32.7) g, 466 (240) µg retinol activity equivalents (RAE), 0.76 (0.22) mg, 0.94 (0.27) mg, 61.0 (28) mg, 522 (167) mg, and 5.3 (1.4) mg. The intake on holidays was 1,372 (295) kcal, 45.7 (12.1) g, 46.9 (14.7) g, 187.5 (42.5) g, 338 (227) µg RAE, 0.66 (0.25) mg, 0.81 (0.33) mg, 60.8 (44) mg, 396 (199) mg, and 4.4 (1.7) mg. The nutrients that had significantly higher values on weekdays than on holidays were energy, protein, carbohydrates, vitamin A, vitamin B_1, vitamin B_2, vitamin C, calcium, and iron. When each nutrient was evaluated in comparison with the Dietary Reference Intake, the proportion of infants who exceeded the estimated average requirement (EAR), the recommended dietary allowance, and the tentative dietary goal for preventing life-style related diseases for all nutrients was significantly higher on weekdays than on holidays. However, even on weekdays, 44% of infants did not meet the EAR for calcium.

Conclusions: The findings suggest that nursery school meals may be the basis of the infants' intake of nutrients on weekdays. In addition, weekday meals are desirable meals for infants. However, calcium intake tends to be deficient, even on weekdays. In the future, countermeasures will be necessary to consider.

Keyword: Nutrition, Childhood, Nursery school, Dietary survey, the Dietary Reference Intake

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PAB(T6)-102
An example of a convergent mixed-methods analysis in examining food security: the case of Popokabaka

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Background: Food security as a unique multi-dimensional concept may underly multiples nutrition problems within a community. Popokabaka is an entirely rural setting with multiple nutrition problems such as Selenium deficiency, Zinc deficiency, iron deficiency, Stunting, etc. To develop effective and long-term interventions to address these nutrition problems, a comprehensive analysis of the burden of food security is needed. We attempted to measure food security at four levels of the food chain and adapt a theory change for a transformative impact on hunger and malnutrition in Popokabaka.

Methods: We designed a convergent parallel mixed-method study with four-level data sources collected from rural Popokabaka, DR Congo: a household food survey (using the Household Food Insecurity Access Scale, Food Consumption Score), a market food census (assessing food availability and cost per 100g), an exit food market survey (assessing food choice and customer's satisfaction) and on-farm qualitative research with food producers (exploring challenges and opportunities). Descriptive statistics from quantitative data were triangulated with emergent themes from qualitative data, and the food and nutrition security's theory of change was used as the framework for interpretation.

Results: The population of Popokabaka experienced severe food access insecurity (89% of Households) and poor food consumption (40,7% of Households), with cassava farming as the primary food stock and subsistence source. Animal sources like meat, fish, and insects were under-consumed and estimated as the most expensive and rare foods on the market. Customers raised poverty and lack of food variety as primary drivers for food choice. Soils scarcity and lack of drugs for epidemics inbreeding emerged as main challenges to food production.

Conclusion: Ending hunger and eliminating malnutrition should be possible through multiple actions along the food chain cycle.

Keyword: Food insecurity, Mixed methods, Sustainability, Markets, Households

Conflict of Interest Disclosure: Authors declare no conflicts of interest

PAB(T6)-103
Association between night-oriented lifestyle and visceral obesity: a cross-sectional study in Japan

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Background and Objectives: Obesity, especially visceral obesity, is a serious risk factor for mortality and cardiovascular diseases. In addition, it is known that night-oriented lifestyle, such as late dinner and late bedtime, is related to obesity. However, little is known about the association between night-oriented lifestyle and visceral obesity. To investigate that association, we performed the cross-sectional study.

Methods: Between April 2012 and March 2019, we recruited 2010 participants who underwent healthcare examination in a single healthcare examination center in Japan and met the inclusion criteria, namely, age 20-65 years, measured visceral fat area (VFA) by dual bioelectrical impedance analysis. Lifestyle behaviors, such as dinner-time and bed-tine, were inquired by a questionnaire. To explore the relationship between night-oriented lifestyle and visceral obesity, defined as VFA ≧100 cm^2, a multivariable logistic regression model was used.

Results: Overall, 1,846 participants were eligible for analysis, 1,124 (60.9%) were men, 618 (33.5%) met the criteria of visceral obesity. There was a significant relationship between late dinner-time and visceral obesity. Compared with dinner-time before 19:00 as the reference category, adjusted odds ratios (AOR) were 1.49 (95 percent confidence interval [CI], 1.00 to 2.22) for dinner-time of 19:00 to 20:00; 1.89 (95% CI, 1.24 to 2.88) for dinner-time of 20:00 to 21:00; 1.83 (95% CI, 1.12 to 2.99) for dinner-time after 21:00. By contrast, obvious relationship was not recognized between late bed-time and visceral obesity. Compared with bed-time before 22:00, AOR were 1.25 (95% CI, 0.71 to 2.17) for bed-time of 22:00 to 23:00; 1.41 (95% CI, 0.84 to 2.36) for bed-time of 23:00 to 0:00; 1.34 (95% CI, 0.79 to 2.25) for bed-time after 0:00. Additionally, compared to participants with early dinner-time (before 20:00) and early bed-time (before 0:00), participants with late dinner-time (after 20:00) and early bed-time (before 0:00) were associated with the risk of visceral obesity. (AOR 1.70; 95% CI 1.24 to 2.33)

Conclusions: In Japanese adults, late dinner was associated with increased risk of visceral obesity. Further research is needed to understand the association between night-oriented lifestyle and visceral obesity.

Keyword: visceral obesity, lifestyle behavior, night-oriented lifestyle, dual bioelectrical impedance analysis

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-104

Nutrient profiling of Indian processed packaged foods using Warning Label, Health Star Rating, and Nutri-score

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Background and Objectives: Processed foods are high in one or more of the nutrients of concern, namely, sodium, sugar, and saturated fat. Front of Pack Labeling (FoPL) assists consumers in making healthy food choices. India has not yet ratified the FoPL. Thus, the aim was to compare three FoPL models in evaluating the Indian processed packaged foods.

Methods: The present study re-evaluated the processed packaged foods (N=1020) studied in 2014-15 for food labels. After scrutiny, 502 products were found eligible for evaluation using Warning Label (WL), Health Star Rating (HSR), and Nutri-score models and were categorized according to the three systems.

Results: Forty percent of the food products (fried snacks, chocolates, soups) qualified for three WLs; 3% had four WLs (non-dairy beverages, fried snacks); 3% were found to be healthy with no WLs (few RTE foods). Majority of these products (73%) were high in calories (chocolates, RTE sweets), 60% were high in sodium (ketchup, RTE foods, noodles), 37% were high in sugar (beverages, RTE sweets) and 55% were high in saturated fat (chips, fried snacks). Thirty-six percent of RTE foods, soups, chocolates received HSR score of 0.5 while jellies, juices, RTE sweets (23%) received 1 star and 1 product earned a score of 5 (breakfast cereal). Twelve percent of products (RTE foods, breakfast cereal) were identified as healthy by Nutri-score (A), 31% (soup, chocolates, fried foods, ketchup) as less healthy (Nutri-score D), and 24% as least healthy Nutri-score of E (non-dairy beverages). Breakfast-cereals (n=35), high in calories and sugar (WLs less than or equal to 2) had good HSR (3 to 5) and Nutri-score (A and B). HSR and Nutri-score award points for positive components (fiber, FVNL, and protein), which offset the negative nutrient points. Ten percent of Non-dairy beverages (fruit juices, and aerated soft drinks; n=81) were identified as unhealthy by WLs (4), Nutri-score (E), and HSR (1) due to high sugar content.

Conclusion: There was fair degree of alignment observed across three FoPL models used for the evaluation of selected Indian processed packaged foods.

Keyword: Processed Packaged Foods , Health Star Rating, Warning label, Nutri-score, Front of Pack Label

Conflict of Interest Disclosure: No conflict of interest

PAB(T6)-105

Development and evaluation of a multidisciplinary education intervention to support the management of malnutrition and oral nutritional prescribing by Irish general practitioners

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Background and objectives: Approximately 10% of adults requiring general practitioner (GP) care are at risk of protein-energy malnutrition (PEM). Prevention of PEM includes identification of risk, nutrition counselling and oral nutritional supplementation (ONS). The Irish Health Research Board-funded *Oral Nutritional Supplement Prescribing (ONSPres)* project aimed to investigate clinical, social and other factors that influence malnutrition identification, management and ONS prescribing by Irish GPs and other healthcare professionals (HCPs) working in the community/primary care setting. These data were used to inform the development and evaluation of an evidence-based e-module for GPs to support malnutrition management and prescribing of ONS.

Methods: Qualitative interviews and focus groups were undertaken with key community/primary care HCPs: GPs, nurses, dietitians, pharmacists, physiotherapists, occupational therapists and speech and language therapists, and with patients with PEM. Interviews and focus group discussions were audio-recorded and transcribed verbatim. The data were coded, analysed and key themes identified. Quantitative analysis of an anonymous dispensed pharmacy claims database that represents 30% of the national claims for ONS in the Republic of Ireland was undertaken to complement the qualitative data and further inform the development of the malnutrition management e-module. The e-module was evaluated by 31 GPs and GP trainees.

Results: The lack of nutrition training amongst GPs and other HCPs was apparent. Due to insufficient awareness, lack of prioritisation and knowledge and inadequate multidisciplinary communication, malnutrition screening did not happen in practice. Poor understanding and negative associations with the term 'malnutrition' were clear amongst patients and non-dietetic HCPs. The quantitative analysis highlighted disparities in ONS use across patient groups, with higher ONS use amongst younger males, patients living in residential care and those on central nervous system polypharmacy. Long-term (12 consecutive months) usage of ONS was characterised by older age and polypharmacy. The malnutrition e-module was well-received and effective in improving knowledge and practice relating to the identification and management of malnutrition, with knowledge retained after 6 weeks.

Conclusions: Availability of an e-module, along with resources to support clinical practice, is an effective method to improve adult malnutrition screening and management among GPs and community/primary care-based HCPs.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Malnutrition, Primary Care, Healthcare professionals, e-module, Management

PAB(T6)-106
Optimizing local diet using linear programming to improve micronutrient intakes of lactating women in rural area of Senegal

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Background and objectives: Micronutrient deficiencies remains a great public health challenge particularly in rural settings. In Senegal, the double burden of malnutrition currently highlighted among women of reproductive age of the groundnut basin become worrisome. To tackle these malnutrition issues, it would be useful to determine the best foods combination to balanced diets. We aimed to use a linear programing method to examine whether optimized diet using a locally-made porridge containing millet, cowpea and orange fleshed sweet potato could meet nutrient requirements of lactating women.

Methods: A dietary survey was carried out among 59 rural lactating women and their children using the weight food record method. All foods and beverages consumed during a whole day were quantify. Nutrient intakes were calculated using the west African food composition tables. Prices (per kg) of foods were obtained from the local shops/markets and the harmonized index of the national agency of statistics. The 22 foods items daily consumed by women with an average of consumption of 15 g were selected for the model. A linear programming method of the excel solver was used to optimize diet with the overmentioned locally-made porridge. The objective function was to minimize the cost of the diet taking into account the constraints related to the recommended intakes of the selected nutrients.

Results: According to the results, the median intakes of the staple diet cover around 70% of the energy and proteins requirements of the women. While, iron, zinc and vitamin A intakes were lower than the recommended dietary allowances. The optimum diet obtained with the add of the porridge (1.46 mg iron, 2.13 mg zinc and 4025 µgRE vitamin A) covers the total (100%) energy (2620.7 kcal), proteins (76.6 g) and iron (15 mg) requirements and more than 200% of the adequacy of fibers, zinc, vitamin C, folate and vitamin A.

Conclusions: These findings support the potential impact of nutrient dense complementary porridge to improve the iron, zinc and vitamin A status of rural lactating women. This model could be adapted for children to reduce micronutrients deficiencies in rural area in Senegal.

Keyword: Linear programming, Micronutrients deficiencies, Lactating women, Rural area, Senegal

PAB(T6)-107
Association of changes in dietary variety with all-cause mortality among older Japanese adults with/without frailty

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Background and objectives: Eating a variety of foods maintains nutritional status and prevents frailty or mortality. We conducted a 2-year community-wide intervention for promoting dietary variety and preventing frailty. However, it remained unclear whether the effect of changes in dietary variety on health outcomes differs with/without frailty. This study examines the influence of changes in dietary variety during 2-year on all-cause mortality among older Japanese adults living in a metropolitan area.

Methods: We performed secondary analysis of data from a community-wide intervention focused on promoting dietary variety in Ota City, Tokyo, Japan. Participants were 7,505 non-disabled residents (3,867 men and 4,137 women) aged 65–84 years who responded to self-administered questionnaire surveys in 2016 and 2018. Frailty was defined as a score of ≧4 on the Kaigo-Yobo Checklist (range: 0-15). Dietary variety was assessed using the dietary variety score (DVS: 0–10 points) and defined as low (0–3) or high (4–10). Participants were classified according to changes in the DVS category between 2016 and 2018; high–high, high–low, low–high, low–low groups. Multilevel survival analyses were conducted to calculate the adjusted hazard ratio (HR) and 95% confidence interval (CI) for all-cause mortality by with/without frailty.

Results: The numbers and rate of high–high, high–low, low–high, and low–low groups were 2110 (35.3%), 549 (9.2%), 852 (14.2%), and 2469 (41.3%) in the non-frailty group, respectively. Corresponding numbers and rate were 325 (21.3%), 125 (8.2%), 211 (13.8%), and 864 (56.7%) in the frailty group. During a follow-up of 3-year, 352 (4.7%) individuals died. Compared with high–high group, HR (95% CI) for all-cause mortality for high–low, low–high, and low–low groups were 1.64 (0.96-2.80), 1.03 (0.66-1.60), and 1.31 (0.74-2.31) in non-frailty group, respectively. Corresponding HR (95% CI) were 2.49 (1.15-5.34), 1.56 (0.61-4.01), and 2.74 (1.14-6.58) in frailty group.

Conclusions: Although changes in DVS categories were not associated with all-cause mortality among non-frail respondents, even those with frailty may be able to reduce their risk of all-cause mortality by maintaining or increasing dietary variety.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Dietary variety, frailty, mortality, older adults, Japanese

PAB(T6)-108
The influence of content, context, and perceptions on defining meat alternatives – A scoping review

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Background and objectives: During the global nutritional transition over the last decade, consumption of meat increased causing irreversible damage to the environment. Since awareness of eating behaviour repercussions is increasing, a shift is observed towards consuming more (plant-based) alternatives to meat. Consequently, this resulted in a novel research area with increasing scientific publications addressing meat alternatives in nutritional, environmental, and consumer sciences. In different fields, researchers use diverging definitions, and no universal definition of what meat alternatives should entail is thus endorsed. Different interpretations could result in discrepancies in research and between researchers, where there is no equal understanding of what is considered a meat alternative. Therefore, we aim to create a definition of what meat alternatives should entail.

Methods: Guided by the PRISMA extension for scoping reviews, literature over the past ten years was systematically searched using keywords like 'meat alternative', 'meat substitute' and 'meat analogue'. This initial search resulted in over 10.000 hits, which were reduced to 2000 during the first exclusion round. Titles and abstracts of these academic published sources were screened, which resulted in 195 articles included in the present review.

Results: Three major influencing facets on the definition of a meat alternative can be derived from the included literature. The first facet describes the production, where the ingredients (like soy, wheat, and textured vegetable protein) and the production process influence the final meat alternative product. Based on this first dimension, a second facet becomes apparent through which several factors are determined, namely sensory characteristics, nutritional value, and sustainability. The third facet observed is the target consumer and the intended consumption context. This last facet, related to the first two, especially determines whether a product is considered an alternative to meat or not.

Conclusions: By considering the different facets presented, we recommend that continuous efforts are made by researchers, policy makers and companies to make meat alternatives more accessible to the different types of consumers. Future research and product development could focus on improving the dietary composition and the addition of functional ingredients of meat alternatives by, for example, the addition of fibre.

Keyword: Meat substitution, Meat replacements, Sustainability transition, Alternative protein, Plant-based food

PAB(T6)-109
Comparison of observed non-compliance with the WHO Code across seven international studies (Indonesia, Vietnam, India, Thailand, Nigeria, Philippines and Mexico)

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Background and Objective: Over 30 years' studies estimate that increased breastfeeding could prevent 832,000 child and 20,000 breast cancer deaths in low and middle-income countries. Children breastfed for longer periods have fewer infections resulting in morbidity and mortality and have higher intelligence. Inappropriate marketing of breast-milk substitutes (BMS) has i shown to undermine optimal breastfeeding practices. The WHO Code was developed to regulate marketing of BMS, and many countries have adopted its provisions into local legislation but to a varying extent. Assessments of the largest global baby food companies' compliance with the WHO Code reveal varying levels of compliance across seven country studies. Westat conducted studies funded by the Access to Nutrition Foundation.

Materials and Methods: All seven studies assessed baby food companies' compliance with WHO Code, including all subsequent World Health Assembly resolutions, and relevant national regulations that go beyond the WHO Code. Westat followed The Interagency Group on Breastfeeding Monitoring protocol in Vietnam, Indonesia, and India. The remaining assessments utilized the WHO/UNICEF Network for Global Monitoring and Support for Implementation of the Code (NetCode) protocol. Researchers systematically collected data of marketing of breast-milk substitutes/complementary foods (BMS/CF) across different channels to assess compliance to WHO Code. Data included: exposure of women to BMS marketing; promotional/educational materials observed in health facilities; marketing/promotions observed in selected retail and online stores; review of baby food product labels/inserts; and media monitoring (traditional and online).

Results: Each country had laws/regulations related to BMS/CF marketing and labeling in varying alignment with WHO Code. Number of non-compliances found varied widely by country and company. In interviews with mothers of infants and young children, television and radio were most frequently cited sources of BMS/CF advertisements across seven countries. Mothers also reported some activity in receiving product samples and contact with company representatives. Key findings

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

reveal that all countries except Thailand, online media promotions far exceeded traditional media promotions. In all countries except Vietnam, online retail promotions were significantly greater than promotions observed in physical retail outlets.

Conclusion: Studies found fewer non-compliances in countries with more Code-aligned regulations. Online promotions contributed to most non-compliances.

Keyword: Breastmilk substitutes, Complementary foods, Marketing, Promotions, Online media

Conflict of Interest Disclosure: None to report

Further Collaborators: None

PAB(T6)-110

Over 80% Vitamin A supplementation coverage reached during the Cameroon's national Health and Nutrition Week Campaign amidst COVID-19 pandemic.

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Background and objectives: Vitamin A deficiency affects 35% of children under the age of five years in Cameroon. The Ministry of Public Health Cameroon, and international actors support the delivery of a twice-yearly integrated package of health interventions including vitamin A supplementation (VAS) through the Maternal and Child Health Nutrition Actions Week (SASNIM). One goal of the SASNIM is to achieve at least 80% VAS coverage among children aged 6-59 months.

Methods/Intervention: The second round of SASNIM was held in Cameroon from November 26-29, 2021. In total, 5,383,077 children aged 6-59 months were targeted during this nation-wide, four-day campaign. Each VAS distribution team consisted of two people (one distributor and one recorder). Social mobilization activities were held two days prior to, and during the first two days of the campaign. The SASNIM followed GAVA's guidance for delivering VAS during the COVID-19 pandemic, a door-to-door campaign strategy for implementation was adopted to administer VAS outside the household or in well-ventilated areas, and personal protective equipment were provided to all front-line workers administering VAS. Training of the importance of COVID-19 prevention measures, and Supervision checklists were enforced among distributors, supervisors and front-line workers.

Results: A total of 4,495,680 (84%) children received VAS during the second campaign in 2021. Coverage results displays three clear patterns, across 10 regions: 1) regions with the majority of the population living in semi-urban or rural sittings obtained a coverage >90% (Adamaoua, North, South, East and Far-North regions), 2) regions with the majority of its population living in urban areas reached a coverage between 70%-90% (Littoral, Center and West regions), and 3) regions in acute civil crisis achieved < 50% (North West and South West).

Conclusion: The second national VAS campaign of 2021 achieved an average administrative coverage of approximately 84%. This coverage is impressive in the context of COVID-19, although further efforts are needed to improve coverage in the country's highly insecure areas.

Keyword: VAS, Vitamin A, Cameroon, SASNIM

PAB(T6)-111

A Peer-led Integrated Nutrition Intervention Using the Care Group Model Improved Infant Growth in South-Sudanese Refugees in Post-Emergency Settlements in the West Nile Region in Uganda

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Background and objectives: Several nutrition-sensitive interventions have been implemented to address malnutrition. However, the efficacy of these programs to reduce undernutrition among refugees remains largely unknown. This study examined the effects on infant growth of a peer-led integrated nutrition education intervention with maternal social support using Care Groups among South Sudanese refugees in Uganda.

Methods: A longitudinal RCT (2 treatment arms and 1 control arm) was conducted among 390 women in their third trimester from different settlements in Adjumani district, Uganda. The moms-only (n=130), moms&dads (n=143) treatment arms and control (n=117) had 10–20 members per group. The treatment arms received the integrated nutrition education intervention using the Care Group model while the control received only standard of care. The WHO standards were used for defining infant LAZ, WAZ, and WLZ. The Medical Outcomes Study (MOS) social support index was used to measure maternal social support. Interaction effects of intervention, social support, and time on infant growth were tested with split-plot ANOVA. Post-hoc analyses determined mean differences in infant growth among the study arms after adjusting for covariates.

Results: The Dinka were the most prevalent (63.3%) ethnic group. More than half (55.6%) of moms were stay-home spouses. The least average stay in a refugee setting was 4.1±1.3 yrs. The mean infant birth weight was 3.1±0.5 kg. Infant stunting was most prevalent in the control arm (> 14%). There were

significant interaction effects of the intervention and social support by time on infant mean LAZ ($F_{(6,560)}$ = 28.91, *p*=0.000), WAZ ($F_{(5.8,539.4)}$ = 12.70, *p*=0.000) and WLZ ($F_{(5.3,492.5)}$ = 3.38, *p*=0.004) with effect sizes *f*=2.4, *f*=1.6, and *f*=0.72, respectively. By the end of the study, simple main effects showed that the intervention improved infant mean LAZ (moms-only vs control (mean difference, *MD*) = 2.05, *p*=0.000; moms&dads vs control, *MD* = 2.00, *p*=0.000) and WAZ (moms-only vs control, *MD* = 1.27, *p*=0.000; moms&dads vs control, *MD* = 1.28, *p*=0.000).

Conclusion: The Care Groups intervention with maternal social support improved infant stunting and underweight. Nutrition-sensitive approaches integrating social behavioral change may provide sustainable cost effective strategies to reduce child undernutrition among refugees.

Keyword: Infant growth, Social support, Refugees, Care Group, Uganda

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: A grant from the Nestlé Foundation for the Study of Problems of Nutrition in the World, Switzerland. Additional funds for this project were also received from the Marilynn Thoma Chair in Human Sciences at Oklahoma State University (Okstate); Esther Winterfeldt Summer Research Fellowship, Okstate, and the Hildebrand Facilities and Administrative Funds, Okstate.

PAB(T6)-112
Well Connected Communities - Culture of health initiative on the Lower Eastern Shore of Maryland: Youth conducting community health assessment using social determinants of health metrics

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Background and Objectives: Health behaviors and the social and physical environment in which individuals live and work have a stronger influence on well-being than clinical services alone. The proliferation of stakeholders' efforts to promote wellness and prevent diseases has led to a vision for a culture of health where every person has equal opportunity to live the healthiest life regardless of their neighborhood, income, or their color. The objectives of the Well Connected Communities - Culture of Health Initiative are to: 1-emphasize community engagement through coalition building; 2-engage Youth in assessing community health needs, developing, and implementing action plans.

Methods: The Culture of Health Action Framework includes four action areas and one outcome area. This project focused on two action areas: "Making health, a shared value" area, and "Fostering cross-sector collaboration for well-being" area. A coalition-building and a multi-sector health council were used to foster cross-sector collaborations – Under youth leadership, a community health assessment survey was developed and conducted. Youth and the research team ensured that each question was associated with the social determinants of health (SDH) metrics. Data were collected in the target community and analyzed using descriptive statistics. The top three issues in the community were identified. Action plans were developed.

Results: Approximately 24 questions were developed. The following SDH metrics were associated with the survey: SDH Health Care metrics(5 questions); SDH Food Metrics (4 questions); SDH environment Metrics (10 questions); SDH Education metrics (3 questions): SDH Economics Metrics (2 questions). No question was associated with SDH Social Metrics. Approximately 120 participants completed the survey. Three top trends were identified: 1-Affordable afterschool programs 2-Food access, and 3- Affordable housing. Two action plans were developed: "Healthy Street Healthy Me" and "Make Fruits and Vegetables Available to All".

Conclusions: Through this project, Youth had a better understanding of their own community health (physical, mental, environmental, and socio-economic health). Their interactions with the adults also emphasized the importance of making health, a shared value in the community. Community Engagement is essential for sustainable changes and equity especially historically marginalized populations and those facing the greatest barriers to good health.

Keyword: Youth, Social Determinants of Health

Conflict of Interest Disclosure: Project funded by Robert Wood Johnson Foundation

PAB(T6)-113
Nutrient profiles of dishes eaten by high salt consumers and adequate salt consumers in the 2014-2018 National Health and Nutrition Survey, Japan

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Background and objectives: Dish based nutrient profile analyses are essential in setting goals to achieve a balanced diet. The Japanese enjoy longevity, but their current diet is still high in salt, which was 10.1g/day among adults in the 2019 National Health and Nutrition Survey. In 2020, the Dietary Reference Intakes for Japanese proposed that adult salt intake to be limited

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

to 7.5g/day for men, and 6.5g/day for women. In order to compare the amount of salt in dishes consumed among the nationally representative sample, we conducted the secondary analyses of the 2014-2018 National Health and Nutrition Survey data.

Methods: Dietary data from 35,915 participants in the 2014-2018 National Health and Nutrition Survey aged 18-74 years who ate three meals on the survey day, were applied for analyses. We extracted 554,257 dishes from each meal, and categorized them according to the definition of "staple dish" (grain dish), "main dish" (meat, fish, eggs, or beans), and "side dish" (vegetables, seaweeds, potatoes, or mushrooms) shown in the 2005 "Japanese Food Guide Spinning Top". Participants were grouped as "high salt" consumers if their intake were equal to or higher than the Dietary Reference Intakes for Japanese (2020), and "adequate" consumers if they consumed less. The nutrient profile of each dish category was compared between the two groups.

Results: 29,403 participants were identified as "high salt" and 6,512 as "adequate". The mean age of the "high salt" group (52.7 years) was higher than the "adequate" group (50.2 years). The mean salt intake in the "high salt" group was 11.3 g/day and the "adequate" group was 5.5 g/day. Among the dishes, 56,701 were categorized as "staple dish", 44,510 as "main dish", 43,868 as "side dish", 28,132 as "combined dish", and 381,046 as "miscellaneous". Regardless of type of dishes, dishes consumed by the "high salt" group were significantly 1.4 to 2.3 times high in salt intake, compared to the "adequate", but not in energy, protein, fat, and carbohydrate.

Conclusions: Our results showed that the "adequate" group was able to consume reduced-salt dishes with most nutrient intake unchanged, compared to the "high salt".

Keyword: Nutrient profile, Sodium, Dish, Dietary survey

PAB(T6)-114
Establishing targets, self-monitoring and decentralized decision making at the health post improves routine VAS coverage in Senegal

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Background and objectives: Coverage rates for vitamin A supplementation (VAS) delivered through routine health services remains low across sub-Saharan Africa. In Senegal, targets for VAS are set and monitored by semester at the district level, but activities are planned for and implemented monthly by health posts. Capacitating health posts to self-monitor monthly VAS coverage and identify solutions to improve coverage regularly is a promising approach to improve routine coverage.

The objective of this research is to document the implementation of the self-monitoring approach and assess its impact on routine coverage rates and in Pete, Podor, Kanel and St Louis health districts of Senegal.

Methods: A cross-sectional representative survey of 1365 households was conducted to assess baseline VAS coverage for the first semester of 2020. Administrative coverage data was recovered from the national DHIS2 monitoring system to report on monthly evolution of coverage from July 2020 to December 2021. Project monitoring reports were exploited to report on the degree of implementation.

Results: Over 18 months, the average VAS coverage increased from 44% to 93%, with all four districts achieving coverage of at least 80%. Baseline coverage was 64% in Podor, 54% in Saint-Louis, 45% in Pete and 12% in Kanel. After one semester of the intervention, average VAS coverage increased to 86%. These improvements were sustained in the first and second semesters of 2021, where average coverage was 92% and 93%, respectively. In the first year, the directorate of maternal and child health (DSME), health districts, and partners outlined an operational plan detailing training, tools, coaching, and coordination needs. All training took place in the first year and included 646 health workers serving 149 health posts. In the second year, the health districts with project staff conducted 81% (n=8) of planned supervisions, 100% of DSME, regional and partner joint supervision. A total of 96% of health center monthly coordination meetings (n=1178) and 66% of monthly district coordination meetings (n=32) integrated the new self-monitoring of VAS targets.

Conclusions: Embedding simple self-monitoring of VAS coverage into health posts monthly coordination is a feasible and an effective strategy to improve routine coverage.

Keyword: Health system strengthening, Vitamin A Supplementation, Implementation research, Self-monitoring , Government coordination

PAB(T6)-115
Validity of Calculation Value of Nutrient Intake by Photographic Dietary Assessment

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Background and Objectives: Nutritional intake estimation from photographs is a simple meal investigation method. We investigated the validity of a method for assessing daily diet.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: Overall, 17 University students (1 man and 16 women, age: 20 or 21 years) enrolled in a dietetic course photographed meals, and kept traditional weighted dietary records for 4 days. Participants were instructed to take pictures with a smartphone camera of all foods and beverages they consumed during 4 consecutive days (2 week days and weekends) and registered all photos, meal times, and food name in dishes using FoodLog Athl, a smartphone application developed for diet recording by Aizawa et al. In addition, participants were asked to keep traditional weighted dietary records on the same days. The individual nutrient intakes were independently calculated two methods. Pearson correlation coefficients for the nutrient intakes were calculated using crude and energy-adjusted values based on the residual method after logarithmic transformation.

Results: The correlation coefficients between two crude and energy-adjusted nutrient intakes by respective methods were high validity (energy (only crude): r = 0.898, protein (crude, energy-adjusted): r = 0.815, 0.752, total fat: r = 0.880, 0.902, carbohydrate: r = 0.884, 0.762, total fiber: r = 0.905, 0.869, calcium: r = 0.834, 0.824, iron: r = 0.821, 0.877, vitamin C: r = 0.929, 0.944 (p < 0.001, respectively). However, the validity of salt was moderate (r = 0.512, 0.705, p = 0.036, 0.002).

Conclusions: Although some adjustments are required for salt, the photo method appears to be useful as a tool for dietary recording tool.

Keyword: photographs, dietary assessment, nutrient, validity

Conflict of Interest Disclosure: KH is a member of the Social Cooperation Program funded by Ajinomoto Co., Sosuke Amano is an employee of food.log Inc.

PAB(T6)-116
The macro- and micronutrient compositions of vegan diet compared to non-vegan alternatives, and their nutritional and health implications in the UK

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Background and objectives: Plant-based diets have become increasingly popular in recent years. Many choose to live vegan by following a 100% plant-based diet. With an increasing range of vegan products on the market, questions arise as to whether these products are nutritionally equivalent to meat-based products. In addition, whether self-prepared vegan meals differ in their nutrient contents compared to meat alternatives. This study aimed to assess the nutritional quality of vegan diets by comparing the nutrient content of vegan products, recipes and meal plans to their non-vegan counterparts.

Methods: The nutrient content of ten popular vegan products from each of the food groups (Fish, Chicken, Beef, Sausages, Cheese, Milk and Ready meals) sold in leading UK supermarkets were analysed against non-vegan alternatives. In addition, ten popular recipes and a 7-day meal plan published on BBC Good Food website in 2021 were selected and their nutritional compositions were calculated and compared between vegan and non-vegan versions.

Results: All categories of vegan products had significantly higher fibre content compared to non-vegan counterparts (P=0.000-0.033). All food categories showed no significant difference in energy, except non-vegan sausages has higher energy (P=0.023) than vegan sausages. Vegan dishes (14.0mg±3.8mg) have higher iron content than meat dishes (12.3mg±1.2mg), however, the bioavailable iron from meat dishes was higher than vegan dishes, estimated using a novel tool developed in-house. The protein content was significantly higher in non-vegan diet than vegan (P<0.001), while the content in both diets fell within the Recommended Nutrient Intakes (RNIs). The vegan diet had significantly lower amount of vitamin B12 (P=0.007), selenium (P=0.002) and iodine (P<=0.001) than non-vegan. Moreover, most vegan products do not commonly or adequately fortify their products with the limiting nutrients in vegan diet.

Conclusions: This study gives an overview of the nutrient profile of vegan products, dishes, and meal plans. A well-planned vegan diet contains enough protein, higher amount of fibre and less saturated fat compared to a non-vegan diet. However, results showed the risk of deficiency in iron, vitamin B12, selenium and iodine in vegan diets and a limited supplementation of these nutrients through vegan products on the UK market.

Keyword: Vegan, Plant-based meat alternatives, Diet quality, Nutrient intakes, Meal analysis

PAB(T6)-117
Fasting duration and metabolic health among men and women: results from a nationally representative nutrition and health survey

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Background and objectives: Recent evidence from animal studies and human clinical trials suggests that intentional longer daily fasting duration (time-restricted eating) improves weight management and metabolic health. However, there is a dearth of research investigating the relationship of daily fasting

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

duration and metabolic outcomes in real-world, free-living population. We aimed to assess this relationship using data from a representative survey in Taiwan. **Methods**: We used data from the Nutrition and Health Survey in Taiwan (NAHSIT) in 2005-2008, a nationally representative survey with a multistage, clustered and stratified complex sampling scheme. Diet was assessed using a one-day 24-h recall. Fasting duration was computed by subtracting the elapsed time between the first and last eating episode (amounting to >=5 kcal) from 24 hours. Outcomes were components of metabolic syndrome [body mass index (BMI), waist circumference, systolic and diastolic blood pressures (SBP, DBP), and fasting plasma triglycerides, high density lipoprotein cholesterol, glucose level], measured during physical examination 1-3 weeks after the dietary interview. Associations between daily fasting duration and outcomes were assessed using multivariable linear regressions adjusting for participant age, sex, educational attainment, employment status, and total energy intake. Survey sampling weight and design were accounted for. **Results**: We included adults (age>=19 years) with plausible energy intake (within 600-4000 kcal/d) and covariates information (*n*=1549–1588 depending on the outcome measures). In total study population, a longer fasting duration was associated with a lower SBP (ß=-0.20 mmHg per 1-h increment in fasting duration, 95% CI: -0.40, -0.01, *P*=0.044) but not with other metabolic components. When stratified by sex, longer fasting duration was significantly associated with a lower BMI (ß=-0.14 kg/m^2, 95% CI: -0.27, -0.01; *P*=0.032) and a lower waist circumference (ß=-0.34 cm, 95% CI: -0.67, -0.01; *P*=0.042) only in women (with further adjustment for menopausal status) and a lower SBP (ß=-0.40 mmHg, 95% CI= -0.75, -0.05; *P*=0.028) only in men. These patterns of observations were similar when fasting duration was modeled as >11.5-h compared to <=11.5-h (population median). **Conclusions**: A longer fasting duration in a real world setting potentially confers sex-specific metabolic health benefits. These observations warrant further replication given the scarcity of evidence.

Keyword: fasting duration, fasting interval, metabolism, metabolic health, chrono-nutrition

PAB(T6)-118
Vitamin D deficiency is associated with less favourable body fat content and distribution in healthy adults-findings from the cross-sectional BODYCON study

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Background and objectives: Although lower 25-hydroxyvitamin D (25(OH)D) concentrations are associated with a greater body mass index (BMI) and increased risk of cardiometabolic diseases (CMD), the relationship with body fat distribution is unclear. Therefore, our objective was to analyse the associations between 25(OH)D concentrations with body composition and CMD risk markers in healthy adults.

Methods: The BODYCON cross-sectional study was conducted in 401 healthy adults (mean age 42 (SE 1) y and BMI of 24.1 (SE 0.2) kg/m^2). Dual energy x-ray absorptiometry assessed body composition and dietary intakes evaluated using a 4-day weighed diet diary. A fasting blood sample was collected to measure CMD risk markers and 25(OH)D concentrations (UPLC-MS/MS). Subjects were stratified according to serum 25(OH)D levels: I (<10ng/mL, severe deficiency), II (10-19.9 ng/mL, moderate deficiency), III (20-29.9 ng/mL, insufficient) and IV (≧30 ng/mL sufficient) and data analysis adjusted for covariates (age, sex, total dietary energy intake and season of study visit).

Results: In this cohort, only 35% of the subjects had sufficient serum 25(OH)D levels, with 3.3% consuming adequate dietary vitamin D. After dividing the group according to serum 25(OH)D levels, the waist:height ratio was significantly higher and android lean mass lower in group I versus group IV (p≦0.02). Percentage android fat and total fat mass were lower in group IV compared to I and II and these findings were associated with a higher total and high-density lipoprotein cholesterol (HDL-C) concentrations (p≦0.01). Percentages of body fat and gynoid fat were also lower in group IV versus all other groups whereas visceral adipose tissue fat mass was lower in group IV compared with group II (p≦0.01). Moreover, there was a tendency for a higher vitamin D intake (p=0.07) and lower BMI (p=0.08) and waist circumference (p=0.09) in group IV. Interestingly, total bone mineral density was not different between groups (p=0.72), with dietary and serum 25(OH)D concentrations only weakly correlated (r=0.15, p=0.01).

Conclusion: These findings suggest that vitamin D deficiency is prevalent in our cohort of healthy UK adults and that sufficient serum 25(OH)D concentrations are associated with more favourable effects on body fat distribution and HDL-C concentrations.

Keyword: Vitamin D, body fat distribution, cardiometabolic diseases

PAB(T6)-119
Trans fatty acid intake and risk of type 2 diabetes: findings from the NutriNet-Santé prospective cohort

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Background and objectives: Type 2 diabetes is one of the most common noncommunicable diseases worldwide, with an

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

increasing prevalence at the global level and a considerable global health burden. Substantial evidence has linked consumption of trans fatty acids (TFAs) to an increased risk of cardiovascular disease. However, the effects of TFAs on type 2 diabetes (T2D) remain unclear. We aimed to investigate the associations between different types of TFAs (total, ruminant, industrial and corresponding specific isomers) and risk of T2D in the NutriNet-Santé prospective cohort.

Methods: Participants aged 18 years or older from the French NutriNet-Santé cohort (2009-2021) were included. Dietary intake data, including usual TFA intake, were collected using repeated 24-hour dietary records. Associations between sex-specific quartiles of dietary intake of TFAs and T2D risk were assessed using multi-adjusted Cox proportional hazard models adjusted for known risk factors (sociodemographic, anthropometric, lifestyle, medical history, and nutritional factors). A total of 969 incident T2D cases occurred during follow-up.

Results: A total of 105,551participants (21,992 men [20.8%] and 83,559 women [79.2%]) were included. Mean age (SD) at baseline was 42.7 (14.6) years. Total TFAs was associated with higher T2D risk ($HR_{for\ quartile\ 4\ versus\ 1}$=1.38; 95% CI=1.11-1.73; P_{trend}<0.001). This association, specifically observed for industrial TFAs (HR=1.45; 95% CI=1.15-1.83; P_{trend} <0.001), was mainly driven by elaidic acid (HR=1.37; 95% CI=1.09-1.72; P_{trend}<0.001), octadecadienoic acid (HR=1.29; 95% CI=1.04-1.58; P_{trend}=0.07) and the *18:t* isomer (HR=1.31; 95% CI=1.06-1.62; P_{trend}=0.006).

Conclusions: Results from this large prospective cohort suggest that dietary intakes of total and several industrial types of TFAs are associated with increased T2D risk. These epidemiological observations are supported by consistent mechanistic plausibility from experimental data. Although these findings need to be replicated in independent cohorts with detailed dietary data, they support WHO's recommendation to eliminate industrially-produced TFAs from the food supply worldwide. In the meanwhile, consumers and patients should be advised to avoid the consumption of food products containing partially hydrogenated oils. This may contribute to lower the substantial global burden of T2D.

Keyword: Trans fatty acids, Type 2 diabetes, Industrial trans fat, Ruminant trans fat, Prospective cohort study

Conflict of Interest Disclosure: Authors declare no conflict on interest

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PAB(T6)-120
Reformulation of Spanish food products with effects on people's health

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Background and Objectives: FAO promotes a health approach as an integrated way to prevent and mitigate health threats at the Animal-Human-Plant-Environment interface. WHO, 2013, present their Global action plan for the prevention and control of non-communicable diseases and assert that the excessive consumption of salt, saturated fat and added sugar has been associated with negative health effects, including obesity, diabetes, cardiovascular disease (CHD), and stroke. European Member States agreed on a Road Map for Action on Food Products Improvement in 2016. Spain agreed to collaborate with it for the improvement of the composition of food and drink and other measures 2017-2020. In order to improve the quality of foods in this way, the industries started to reformulate their products in accordance with the NAOS Strategy in Spain, aligned with European health policy. The objective of this study is to ascertain the level of reduction of salt, saturated fat and added sugar in different groups of foods.

Methods: We selected 8 food groups (250 products) that are those that contribute more than 45% of the total daily energy intake and determined theaverage reduction of salt, sugar and saturated fat, for each group. All values were taken of the nutritional label information.

Results: Dairy products: 47% sugar free; Cookies: reducing 47% saturated fat, 7% of add sugar and 30% of salt; Industrial pastries: reducing 21% saturated fat, 13% of add sugar; Breakfast cereals: reducing 10% of sugar; Vegetables creams: reducing 6.7% of salt; Pre-prepared dishes: reducing 10% of salt; Processed meat: reducing between 5 and 15%; Snacks: reducing 5-13%% of salt and 10% of saturated fat

Conclusions: Our study of such food products demonstrates the effort made by companies to improve their compositions with reformulations in the reduction of sugar and/or saturated fat and/or salt content.

Keyword: Reformulation, Food, Healthy , Industry

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: No further collaborators

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-121
Who is consuming ultra-processed food in Canada? A cross-sectional analysis of the 2018/2019 International Food Policy Study

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Background and objective: High consumption of ultra-processed food (UPF) is associated with low-quality diet and risk of non-communicable diseases, including obesity, cancer, and metabolic diseases. In 2015, nearly half of calories in the Canadian diet were estimated to come from UPF. This study aimed to update estimates of UPF consumption for 2018-2019 and to characterize any variation across sociodemographic subgroups including age, sex, education, income, ethnicity, household food security status, and province.

Methods: This cross-sectional study used data on adults (≧18 years, *n*=5,907) from the International Food Policy Study (2018-2019). All foods and drinks reported in a single 24-hour dietary recall were classified according to the NOVA classification as 1) unprocessed and minimally processed foods; 2) processed culinary ingredients; 3) processed foods; and 4) UPF. Mean relative intakes (% kcal of total energy) of total UPF and subcategories of UPF (e.g., commercial bread, fast-food and frozen dishes, cheese products) among sociodemographic subgroups were estimated using population ratios. Multivariable linear regression analyses evaluated the association between sociodemographic characteristics and UPF consumption.

Results: Adults consumed, on average, 45.3% of their energy from UPF, 40.9% from unprocessed and minimally processed foods, 7.0% from processed foods, and 6.2% from processed culinary ingredients. Overall, UPF consumption was higher among respondents with inadequate versus adequate income (49.3% vs. 45.0% of total energy, p<0.04). Adults aged 51-64 years consumed less UPF (46.8% of total energy) than younger adults aged 18-30 years (49.6%, p<0.04). There was also variation by province of residence, but not by other sociodemographic characteristics such as sex and education. For all subcategories of UPF, except for cheese products, several differences were observed across sociodemographic subgroups. For example, males and younger individuals (18-30 years) consumed more calories from fast-food and frozen dishes than females and older individuals (65+ years), respectively.

Conclusions: UPF consumption was relatively high among Canadian adults in all sociodemographic subgroups, but there was variation by income adequacy, age group and province. Additional research is needed to better understand these differences and to design effective interventions aimed at decreasing UPF consumption in the overall population and in specific subgroups.

Keyword: Ultra-processed food, Socio-demographic characteristics, Public health nutrition, Population diet, Nutrition

Conflict of Interest Disclosure: David Hammond has served as an Expert Witness on behalf of public health authorities in response to legal challenges from the food and beverage industry

Further Collaborators: Didier Garriguet, Health Analysis Division, Statistics Canada, Ottawa, Canada

PAB(T6)-122
Characterizing the retail food environment in three regions of Niger uncovers opportunities to invest in nutrition

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Background and objectives. Consumers in low-income countries are increasingly purchasing their food. However, little is known of these retail food environments and how they influence food access and choice. The study aimed to characterize the retail food environment in the Tillabéry, Maradi and Zinder regions of Niger to inform an intervention that supports food supply chain actors in order to increase consumer access to nutritious foods.

Methods. We conducted (i) a market census in 10 large weekly sentinel markets divided into segments and (ii) point of sale surveys of vendors in 16 villages in September 2021. The nutrition environment monitoring survey for stores (NEMS-S) was adapted for use in informal markets. The census covered all market food vendors (n=4080) to assess food availability, and a detailed survey was conducted with a sub-sample (n=177). In villages, we identified five common vendor typologies (boutiques, semi-permanent stands, prepared food stands, butchers, and street vendors) and sampled two of each per village (n=197). Point-of-sale surveys assessed price, quality, marketing practices, and vendor characteristics.

Results. Snacks were the most carried food item in both villages and markets (22% of market vendors - 71% of boutiques). Marketing was limited to these items (84% of messages), though the use of marketing overall was low. Vegetables (16%), pulses (19%), and dairy products (13%) were the most commonly available micronutrient-rich foods. Animal source foods were carried by few vendors (7%), with poultry and eggs being especially scarce. The 10 cheapest food items included five fruits and vegetables, two snacks, fresh milk, and chicken pieces. Easily storable foods had the most stable reported prices across seasons. Nearly all market segments had visible waste (94%) and few had any waste management (20%).

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Villages had similar results, with better hygiene and were open longer hours and more days per week.

Conclusions. Consumers are confronted with high availability and advertising of snack foods, in environments with varied availability of fruits and vegetables, low availability of animal source foods, and limited hygiene. These results suggest transitioning food environments. Efforts to improve these should increase transformation of perishable nutritious foods and reduce marketing of snack foods.

Keyword: Nutrition transition, Food Environment , Informal markets , Food systems, Supply chain interventions

PAB(T6)-124
An audit of plant-based meat alternatives available in the UK and Ireland

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Background and objectives: A growing concern around animal welfare and the environmental impact of food production and consumption has resulted in an increased demand for plant-based meat alternatives (PBMAs) in the UK and Ireland.[1] While the popularity of these products is increasing, little is known about their nutritional and ingredient composition.[2] Therefore, this study aims to provide an insight into the profile of PBMAs available in the U.K and Ireland.

Methods: An online audit was conducted from February – April 2021. On-pack information was extracted for PBMAs available in the two largest supermarkets in the U.K and Ireland (Tesco and Sainsbury's). PBMAs were defined as products which aimed to imitate meat. Extracted data was organised into four interrelated databases and analysed using descriptive statistics.

Results: 351 products were identified across 20 categories. Meat-free chicken (n=71), sausages (n=56) and burgers (n=49) were the largest product categories accounting for ~50% of all products. The number of ingredients ranged from 3 to 86 with the largest number of products containing between 21-30 ingredients (30%, n=117). Soy and pea protein were the most used protein sources, found in 80% of products collectively (45%, n=157 and 35%, n=122 respectively). 88% of products (n=308) contained ≧ 1 identified allergen. The mean nutrient ranges across the 20 categories per 100g of product were, energy: 86.0-207.5kcal, protein: 2.8-23.3g, fat: 2.0-12.1g, saturated fat: 0.4-2.5g, carbohydrates: 7.3-24.5g, sugars: 1.3-6.7g, fibre: 1.7-8.5g and salt: 0.5-1.9g.

Conclusions: Half of the 351 products identified in this audit fell into the chicken, sausages or burger category. The large range in the number of ingredients and mean nutrient content across the different categories indicates variability in composition. The presence of allergens in majority of these products limits their consumption for a sub-set of the population, unlike most meat products (except fish and shellfish). Therefore, careful consideration should be made when selecting PBMAs from a nutritional and allergen perspective.

[1] Mintel. Plant-based push: UK sales of meat-free foods shoot up 40% between 2014-19. Mintel Reports. 2020.

[2] Hu FB, Otis BO, McCarthy G. Can plant-based meat alternatives Be part of a healthy and sustainable diet? Jama. 2019;322(16):1547–8.

Keyword: Plant-based meat alternatives, Meat analogues, Meat substitutes, Audit

PAB(T6)-125
Nutrient Adequacy and Environmental Impact of Derived Dietary Patterns in Vietnam

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Background and objectives: Accomplishing the target of balancing both environmentally sustainable and healthy diets is a challenge for many countries. Few studies so far have investigated diet quality in Vietnam and its potential impact on the environment. However, there is no study in Vietnam on dietary patterns and the relationship between nutrient adequacy and environmental impact. Therefore, this study aims to analyze the most common dietary patterns of Vietnamese women and explore the association between nutrient adequacy and the environmental impact of these patterns.

Methods: The nationally representative General Nutrition Survey of 2009-2010 was used to analyze the dietary patterns. Dietary patterns were derived using principal component analysis (PCA). Nutrient adequacy and dietary diversity scores were applied to measure diet quality, and greenhouse gas emissions (GHGE) were selected as an environmental impact indicator. The generalized linear model was used to determine the association between diet quality (nutrient adequacy) and the environmental impact (GHGE) of those dietary patterns.

Results: With PCA, three dietary patterns were identified: An Omnivorous, Traditional, and Pescatarian pattern. All three patterns were associated with better diet quality compared to the average diet. Within three dietary patterns, the Omnivorous dietary patterns performed best with the highest mean probability of nutrient adequacy and dietary diversity scores. When adjusted for the region and socioeconomic status, we found positive associations between nutrient adequacy and GHGE in the average diet, a Traditional, and Pescatarian patterns, i.e. every 1kg CO2 eq. increase in the GHGE increased the odds of nutrient adequacy by 1.04 (average diet), 1.09 (Traditional pattern), and 1.07 (Pescatarian pattern). However, no association was found between nutrient adequacy and GHGE in the Omnivorous pattern.

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DOI: 10.1159/000530786

Conclusions: The findings indicated that there would be trade-offs between improving diet quality (nutrient adequacy) and reducing the environmental impact. Switching to a diet with lower GHGE may not achieve nutrient adequacy among Vietnamese women. To accomplish both a reduction of GHGE and sufficient nutrient adequacy, a substantial change of diet would be required.

Keyword: Nutrient adequacy, Greenhouse gas emissions, Dietary patterns, Dietary diversity, Food system

PAB(T6)-126
The carbon footprint of moderate-cost food basket in Serbia

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Background and objectives: Climate change and food production are closely related. The food chain emits greenhouse gases (GHGs) at each stage; e.g. throughout farming process, production, distribution, refrigeration, retailing, food preparation, and waste disposal. One-third of global greenhouse gas emissions comes from food production and consumption. Food chain sustainability, including reducing food emissions is one of the best and easiest approaches to reduce human impact on the planet. National shopping basket is a tool that reflects the product's share of households' spending in the certain country. This study was designed to examine the sustainability of Serbian affordable foods by calculating their carbon footprint using food items of moderate-cost shopping basket in Serbia.

Methods: The structure of the moderate-cost shopping basket for a family of three in Serbia is published on a monthly basis by the Ministry of Trade, Tourism and Telecommunications. Food list includes 73 food items categorized into 9 groups such as cereals, vegetables, fruits, meats, fish, fats and oils, dairy products, non-alcoholic beverages, and miscellaneous other foods. Food carbon footprint calculator *My Emissions* was used for estimation of emission of all food items in the basket.

Results: The monthly quantities, intended for family of three, of each food item were multiplied by its carbon footprint and summed up the values to derive an estimate of greenhouse gases emission (335504 gCO2e). Comparing obtained estimates with globally fair daily food emissions value of 3.05 kgCO2e, it was pointed out that emissions of moderate-cost food basket in Serbia per person on daily basis is around 20% higher.

Conclusions: Based on that, it can be concluded that Serbian government should introduce educational and official programs towards promoting the idea of sustainable food choices in order to contribute worldwide strategy for lower global emission.

Keyword: food production, CO2, emissions, food chain, sustainability

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: /

PAB(T6)-127
Are communities ready to address the issue of poor food safety and nutritional quality in urban Senegal?

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Background and objectives: In Senegal, increased prevalence of overweight/obesity and diet-related non-communicable diseases is of paramount concern, urging the transformation of food systems to deliver more nutritious and safe foods. Community involvement is recognised as an important factor in the success and sustainability of efforts to promote healthy eating and prevent overweight/obesity. Therefore, this study aimed to assess communities' readiness to address the issue of poor food safety and nutritional quality of foods available in their food environments (i.e., places where consumers acquire or consume foods) in urban Senegal.

Methods: The Community Readiness Model (CRM), consisting of 36 open questions that revolves around five dimensions of readiness (community knowledge of efforts, leadership, community climate, knowledge of the issue and resources) was used. Community leaders and actors who play a key role within the food environment were individually interviewed in two neighbourhoods of Guediawaye (n=9) and Dakar (n=10). Interviews were scored with a maximum of 9 points per dimension (1= no awareness, 9= high level of community ownership) and thematic analysis was conducted on key informants' recommendations to ensure nutritious and safe food systems.

Results: Both communities reached the stage of 'vague awareness' of the issue, with a mean score of 3.00 ± 1.94 in Guediawaye and 3.11 ± 1.58 in Dakar. Both communities scored highest for 'knowledge of the issue' (6.00 ± 2.44 in Guediawaye; 5.69 ± 2.08 in Dakar), while the lowest scores were found for 'community knowledge of efforts' (1.46 ± 0.81 in Guediawaye; 1.86 ± 2.30 in Dakar). Leaders' concern and prioritisation of this issue was perceived as inexistent in both neighbourhoods, contrasting with high levels of community concern. Proposed solutions included: raising community awareness, improving sanitation infrastructure locally and nationally, and increasing government involvement.

Conclusions: While several key informants recognised the lack of nutritious and safe food is a concern, they also

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DOI: 10.1159/000530786

highlighted other priority issues, such as lack of financial security, infrastructure and/or food insecurity/hunger within their communities. Encouraging community readiness through public awareness campaigns and increasing government engagement is needed before interventions to promote safe and nutritious food in urban Senegal can be introduced.

Keyword: Community readiness, Food environment, Nutritional quality, Food Safety, Senegal

Conflict of Interest Disclosure: No conflict of interest

PAB(T6)-128

Short stature in relation to severity of anemia using 2 hemoglobin correction factors to altitude in Peruvian 6 to 59 months old children

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Background and objectives: Child malnutrition is a serious public health problem in the world, as it compromises physical and cognitive development and negatively impacts health throughout life. Anemia and short stature are two consequences of malnutrition, which tend to occur together, especially in developing countries. In addition, in populations living at high altitudes, it is proposed to use a hemoglobin correction factor. Our objective was to assess the risk of short stature in relation to the presence and severity of anemia using 2 hemoglobin correction factors.

Methods: The open database of the Peruvian government for 2019, 2020 and 2021 was used, with 760763 children between 6 and 59 months, living from 2 to 4801 meters above sea level. The raw value for WHO was used, the conventional correction factor proposed by the CDC: [adjusted Hg] (g/dL) = -0.032 x (Altitude in meters x 0.0033) + 0.022 x (altitude in meters x 0.0033)^2 and the most recent by Sharma et al. [Adjusted Hg] (g/dL) = 0.0048108*altitude+0.0000004*altitude^2. The cut-off points were mild (10-11 g/dL), moderate (7-9.99 g/dL) and severe anemia less than 7 g/dL. A prevalence ratio was performed with the statistical program SPSS 16.

Results: The percentage of children with total anemia were according to WHO (15.97%), CDC (28.07%), Sharma (34.31%). The following risk values for short stature are presented with a 95% confidence interval, according to the WHO, for mild anemia 1.06 (1.04-1.08), moderate 1.24 (1.20-1.27), severe 3.02 (2.27-4.04); according to the CDC, mild anemia 1.24 (1.22-1.26), moderate 1.52 (1.49-1.55), severe 2.34 (2.11-2.60); and according to Sharma, mild anemia 1.15 (1.14-1.17), moderate 1.49 (1.46-1.52), severe 2.56 (2.26-2.89). These results indicate a significant increased risk of short stature even with mild anemia and it increases as the severity of anemia increases, with the highest risk of short stature with severe anemia.

Conclusions: At the public health level, it is a great challenge to reduce malnutrition in children, however, it is necessary longitudinal studies to establish the optimal growth pattern and hemoglobin levels at high altitude and thus choose the best correction factor, and in this way direct resources more precisely.

Keyword: malnutrition, hemoglobin, anemia, altitude, short stature

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PAB(T6)-129

Food security implications of COVID-19 pandemic among Indigenous peoples living in urban areas of Saskatchewan, Canada

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Background and objectives: The COVID-19 pandemic and associated economic and social responses (e.g., quarantines, business closures) may adversely affect food access and increase food insecurity among at-risk populations such as Indigenous peoples. Therefore, we aimed to assess the food security implications of COVID-19 pandemic and lockdown among off-reserve Indigenous people in Canada. **Methods**: In collaboration with Indigenous co-researchers, we developed an online survey questionnaire containing four subscales: background information, Household Food Security Survey Module (HFSSM), food access, and traditional food consumption. The survey was distributed via SurveyMonkey® to Indigenous adults living in urban areas of Saskatchewan, Canada between August 2021 and March 2022. **Results:** Out of 99 off-reserve Indigenous peoples who participated in our survey, 78.6% were females, 18.4% were males and 3.0% were other genders with mean age of 35.8 ± 12.5 years (18-75 years). A large proportion of the respondents were single (47.4%), had full-time jobs (50.5%), had at least a bachelor's degree (33.3%), and lived in households with four or more members (46.3%). During the first four months of COVID-19 pandemic, 65.9% of off-reserve Indigenous peoples in Saskatchewan experienced some level of food insecurity (27.3% severe, 28.4% moderate, 10.2% marginal). During the same time period, food price increases (47.0%) and limited food availability at markets (38.6%) were reported as the main challenges in accessing food. About 39.2% of respondents also reported challenges in accessing traditional foods during COVID-19 pandemic. Eating less than usual and less preferred foods (25.9%) along with seeking help from food banks, welfare and

community agencies (25.9%) were the most frequently reported coping strategies used by individuals living with food insecurity. About 50% of respondents reported receiving no government financial support during the COVID-19 crisis. **Conclusions:** The short-term effects of the COVID-19 pandemic are exacerbating existing disparities and disproportionately affecting off-reserve Indigenous households that already struggle to meet their basic needs. The issues with supply chain and consequent increase in food cost are creating additional concerns. A rapid, comprehensive policy response is required to mitigate the adverse effects of COVID-19 pandemic on food security status of off-reserve Indigenous peoples in Canada.

Keyword: Food security, Traditional food, COVID-19 pandemic, Indigenous peoples, Canada

Conflict of Interest Disclosure: none

PAB(T6)-130
Using formative research to design an environmental and participatory intervention program for promoting healthy eating and physical activity in elementary schools in Acatlán de Juárez, México: methods and results.

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Background and objectives: In Mexico, one in three children between 5 and 11 years old is overweight or obese; likewise, since 2006, Jalisco has maintained one of the highest prevalences of overweight and obesity. One of the main reasons is the consumption of ultra-processed foods and sugary drinks and low physical activity levels. Mexican children spend about a third of their time awake in school; unfortunately, most offer a food environment that promotes these unhealthy behaviors. This work describes the methods and key findings of formative research conducted in 3 elementary public schools in a semi-urban municipality in Jalisco, Mexico, intended to help design an environmental and participative program to promote healthy eating and physical activity.

Methods: Formative research was based on a similar project in Mexico City, based on the ecological model with a mixed-method approach. Qualitative (direct observation, in-depth interviews, and focus group discussions) and quantitative (closed-ended surveys, checklists) methods were employed to identify context, dynamics, resources, barriers, and facilitators to healthy eating inside the school and surroundings. BMI for age was measured in a parallel evaluation in the nearby schools.

Results: Formative research key findings were used for designing environmental, inter, and intrapersonal strategies to discourage the consumption of energy-dense foods and sugary beverages. The three schools have a food environment that promotes sedentarism and unhealthy eating several times of the day, from before the classes begin until the children go home. Also, a high prevalence of overweight and obesity was found (35%). Furthermore, parents, principals, and teachers' beliefs, motivations, and daily dynamics influence these unhealthy food environments, like time to prepare food, financial issues, and misunderstanding about healthy and unhealthy foods and beverages. Moreover, there was a lack of staff and infrastructure maintenance. Besides, some aspects that could facilitate healthy eating and physical activity were observed, like large areas inside the school and some interested parents.

Conclusions: Formative research was essential to understand the school's food environment and key actors' dynamics to design a context-specific healthy eating and physical activity promotion program.

Keyword: childhood obesity, school environment, healthy eating, physical activity, Mexico

Conflict of Interest Disclosure: All authors declare that they have no conflicts of interest.

The project was funded by Tresmontes Lucchetti and ITESO, Universidad Jesuita de Guadalajara.

PAB(T6)-131
Landscape analysis of nutrition services at preschools and primary schools in Vietnam

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In Vietnam, double burden of malnutrition, which is the coexistence of under- and over- nutrition in the same population, is a prominent public health concern. While prevalence of stunting is still high, account for 19.6%, overweight and obesity has been increasing to 11.1% in under 5 children. The latest annual national nutrition survey shows that the prevalence of overweight and obesity increases as children get older from 7% in under 5 to 19% in 5-19 years old. The reason of having more overweight among older children is implied due to unhealthy diets and physical exercise. Since schools are an attractive entry point to improve children's dietary habits and their life style, the National Strategy on Nutrition for 2021-2030 and the School Health Scheme for 2021-2025, signed by the Prime Minister in 2021, both set goals on school meals and nutrition education for students at all levels. To implement school-based programs and projects, Vietnam is gradually developing policies and relevant resources for school nutrition. A training system on dietitian has been established over 8 years with intensive supports from Japan Dietetic Association. Bachelor training programs for dietitian started from Hanoi Medical University and recently is expanded

to other 8 universities nationwide. About 200 dietitians graduated from these universities are trained for meal management and nutrition education at multiple facilities. There is a rise of public expectation for the bachelors in playing a role to facilitate school nutrition in the future and to improve nutritional status among school children. This study will introduce a landscape analysis used mixed method of a quantitative study followed by qualitative exploration regarding the current school meal provision and nutrition education in selected preschools and primary schools, and to discusspotential entry points for dietitians to play key roles at schools in Vietnam.

Keyword: school nutrition, school meal, nutrition education, role of dietitian, Vietnam

Conflict of Interest Disclosure: none

PAB(T6)-132
Association between personality traits and food stockpiling for disaster

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Background and objectives: 46.2% of the households had no food stockpiled for potential disasters in Japan in 2019. although Japan has experienced many large disasters in the last 10 years, the improvement rate from 2011 (the year of the Great East Japan Earthquake) is only 6.4%. In order to improve the food stockpile rate of households, it needs a new approach that is different from the past. By clarifying the personality traits associated with not having food stockpiling, it may be possible to find an approach suitable for that personality traits. However, it is unknown whether personality traits are associated with food stockpiling for disaster. The purpose of this study is to clarify the association between personality traits and food stockpiling for disaster. **Methods:** A survey was conducted between December 18 and 20, 2019, using a web-based questionnaire. The participants were 1200 adults registered with an online survey company who live in the top five prefectures with a high risk of food shortage due to the Nankai Trough earthquake. It was analyzed the association between the Big Five personality traits and food stockpiling status. The Big Five personality traits assess five basic dimensions of personality. To measure these personality traits, we used the Japanese version of the Ten-Item Personality Inventory (TIPI-J). **Results:** In total, 1192 responses were analyzed, excluding those whose responses to sex and educational background are “others” (n = 3 and n = 8, respectively). The Mann-Whitney test revealed that no significant difference between any Big Five personality scores and food stockpiling status. Additionally, logistic regression analysis reported that none of the Big Five personality traits were significantly associated with food stockpiling. **Conclusions:** The Big Five personality traits may not be associated with food stockpiling for disaster. In order to clarify a new approach to promoting food stockpiling for disaster, it may be necessary to consider from another perspective in the next study.

Keyword: Food stockpiling, Food for disaster, Disaster preparedness, Big Five personality traits

PAB(T6)-133
Arsenic exposure increases the risk of mild cognitive impair and dementia

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Background and objectives: A few studies have explored the relationship between arsenic exposure and dementia, but the results are inconsistent. The purpose of this study is to test the hypothesis that arsenic exposure increases the risks of mild cognitive impair (MCI) and dementia.

Methods: We used data from 1899 adults aged 55 years and older who participated in the China Health and Nutrition Survey, an ongoing cohort study, and provided toenail samples in 2009 and were followed up in 2015. We measured arsenic concentrations (As) using inductively coupled plasma mass spectrometry (ICP-MS) and assessed cognitive impairment and dementia by the Montreal Cognitive Assessment (MoCA) and Mini-Mental State Exam (MMSE) test. We used generalized logit model to explore the relationship between arsenic concentrations on toenail samples and MCI and dementia.

Results: About 18.2% of participants in the study had MCI and 11.7% had dementia. Compared to participants with low levels of As, participants with intermediate levels of As had a 40% higher risk of MCI (RR = 1.40, 95% CI: 1.01–1.82, $p < 0.05$) and a 42% higher risk of dementia (RR = 1.42, 95% CI: 0.99–2.04, $p = 0.055$); participants with high levels of As had a 30% higher risk of MCI (RR = 1.30, 95% CI: 0.97–1.75, $p = 0.082$) and a 57% higher risk of dementia (RR = 1.57, 95% CI: 1.11–2.24, $p < 0.05$). After adjusting for age, sex, education, occupation, and resident areas, their RRs were 1.30 (95% CI: 0.96–1.76, p =0.096), 1.34 (95% CI: 0.91–1.97, p =0.13), 1.21 (95% CI: 0.88–1.65, p =0.24), and 1.52 (95% CI: 1.04–2.23, p =0.030), respectively.

Conclusions: Relatively high levels of arsenic exposure significantly increase the risk of MCI and dementia among older Chinese. These findings could have significant impacts on policies and interventions to control and prevent dementia older adults.

Keyword: Arsenic, Mild cognitive impair , Dementia, China Health and Nutrition Survey, Cohort study

Conflict of Interest Disclosure: No Conflict of Interest.

PAB(T6)-134

Estimates and trends of zero vegetable or fruit consumption among children aged 6-23 months in 64 countries

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Background and objectives: Children require a diverse diet, that includes vegetables and fruits, to support growth and development and prevent non-communicable diseases. The WHO-UNICEF established a new infant and young child feeding (IYCF) indicator: zero vegetable or fruit (ZVF) consumption among children aged 6-23 months. We estimated the prevalence, trends, and factors associated with ZVF consumption in low-and-middle-income countries.

Methods: We examined 129 Demographic and Health Surveys in 64 countries with data on whether a child ate vegetables or fruits the previous day. Prevalence of ZVF consumption was calculated by country, region, and globally. Country trends were estimated and tested for statistical significance (p<0·05). A multivariate analysis was used to examine the relationship between ZVF and child, mother, household, and survey cluster characteristics by world region and globally.

Results: Globally ZVF consumption was 46·3%, with the highest prevalence in West and Central Africa (56·1%) and the lowest in Latin American and the Caribbean (34·5%). Recent trends in ZVF consumption varied by country (17 decreasing, nine increasing, 14 no change). Children from wealthier households and children of mothers who are employed, more educated, and have access to media were less likely to consume ZVF.

Conclusions: The prevalence of children aged 6-23 months who do not consume any vegetables or fruits is high and is associated with wealth and characteristics of the mother. Programs should focus on improving the food environment and providing IYCF counseling.

Keyword: Infant and Young Child Feeding, Zero Vegetable and Fruit consumption, Complementary feeding , Nutrition , Policy

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-135

Relationship between the decrease of energy intake in summer and fat energy ratio

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Background and objectives: Dietary intake changes seasonally and decreases in the hot summer environment, resulting in weight loss (Nutrients 2022, 14, 506). Decrease in dietary intake is considered to promote histamine synthesis in a high-temperature environment, and the intake is suppressed by stimulation of the satiety center via histamine neurons. Preliminary experiments have shown that dietary intake suppression tends to be accelerated when the F % (fat energy ratio) in the diet is low, such as in high-carbohydrate diets during summer. In this study, we conducted experiments on young athletes to test the hypothesis that a low-fat diet induces a decrease in dietary intake as compared to a high-fat diet during summer.

Methods: 1. Twenty-eight young women participated in the study during winter and summer. A dietary survey was conducted using the weight-recording method, and body composition was measured using bioelectrical impedance method. 2. Forty-two male high-school baseball players participated in the study during winter and summer. A dietary survey was conducted using the same method as in experiment 1. The body weight, midarm circumference (MAC), and calf circumference (CC) were measured as physical parameters.

Results: Changes in the energy intake during summer and winter were negatively correlated (p = 0.082) with the energy composition ratio (F %) of fat in baseball players. Thus, energy intake may easily decrease during summers in players consuming a low-fat diet. The subjects were divided into two groups: one with a decrease of energy (L) and the other with no decrease of energy (H) during summer. F % of the L group (26.8%) tended to be lower than that of the H group (30.5%, p=0.056). The MAC of the H group tended to slightly increase and be subsequently maintained, while that of the L group tended to decrease (p=0.074).

Conclusions: The decrease in energy intake during summer indicated a large negative effect on physique, including body weight and MAC. For school baseball players, high-carbohydrate diets may not be optimal during summers.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-136

Nutrient adequacy of Japanese schoolchildren on days without a school lunch as an alternative to household income

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Background and objectives: School lunches are important for adequate nutrient intakes in children. Nutrient intake is inadequate among children from low-income households on days without a school lunch. However, questions about household income are often not responded to due to privacy reasons. We conducted a cross-sectional study to develop a questionnaire to assess nutrient adequacy of children on days without a school lunch as an alternative to household income.

Methods: Participants were 691 children aged 10-11 years from 19 public primary schools in four prefectures of East Japan. The participants completed 24-h dietary records with meal photographs for 2 days without a school lunch. Children's guardians completed a questionnaire about reducing their intakes of the following foods due to economic reasons: “fruits and vegetables”, “meat and fish”, “food you wanted”, and “food you needed”. Using reference dietary intakes, intakes of energy and 25 nutrients were evaluated to assess nutrition adequacy. Logistic regression analyses were used to estimate the odds ratio for poor nutrient intake in participants, after adjustment for confounders.

Results: Participants who often or occasionally reduced their intakes of fruits and vegetables due to economic reasons had significantly higher rates of inadequate intakes of energy and 7 nutrients (vitamins A, E, and B_2, K, Ca, Mg, and P) compared to those who did not or rarely reduced their intakes. Participants who often or occasionally reduced their intakes of the foods they wanted due to economic reasons had significantly higher rates of inadequate intakes of energy and 7 nutrients (proteins, fibers, vitamins E, B_2, and C, Ca, and P) compared to those who did not or rarely reduced their intakes. Only a few nutrients showed significant differences between the respondents to questions about reducing their intakes of meat and fish, and foods they needed. Importantly, those nutrients also showed significant differences among respondents to the first two questions.

Conclusions: The questions about reducing children's intakes of fruits and vegetables, and food they wanted due to economic reasons are useful to assess nutrient adequacy on days without a school lunch as an alternative to household income.

Keyword: Japan, Socio-economic disparity, Schoolchildren, Nutrient adequacy, Dietary reference intakes

PAB(T6)-137

The effectiveness of workplace-based nutrition-specific or -sensitive interventions in improving nutritional outcomes among women and their offspring in low-and middle-income countries: a mixed-methods systematic review

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Background and objectives: Women working in the factory sector are highly vulnerable to poor diets, malnutrition and associated health issues. This review aimed to synthesise the most recent evidence from LMIC settings on i. the impact of workplace-based (i.e., factories/industries) nutrition-specific or -sensitive interventions on nutritional outcomes amongst women and their offspring, and ii. barriers and facilitators influencing these outcomes in the workplace.

Methods: We conducted a mixed-method systematic review (PROSPERO CRD42021246799) of peer-reviewed literature including searches in the following databases: PubMed (Medline), Cochrane CENTRAL, CINAHL, EMBASE and Google Scholar. Risk of bias was assessed using the RoB2 tool for trials and CASP for qualitative studies. Narrative synthesis will be performed alongside meta-analysis where possible. Certainty of evidence will be assessed using GRADE.

Results: Nine articles from five countries located in Africa and Asia, published over the last decade, were included: two quantitative, four qualitative and three mixed-methods. Most studies were conducted in factories within the readymade garment industry. All interventions were nutrition-specific, including dietary supplementation with or without behaviour change communication programmes, and counselling on infant and young child feeding practices. The quantitative evidence yielded mixed results. Barriers to the successful implementation of a nutrition-specific intervention were reported in one study. These included the intervention delivered during working hours; lack of support from managers; and lack of information on benefits regarding dietary supplementation. Other factors that act as barriers within the workplace to women and their offspring achieving good nutrition included absence of maternity leave; excessive workload; safety issues (chemicals); inadequate health services; lack of facilities to express/ store breastmilk and lack of childcare options. Facilitators of good nutrition practices included women-friendly workplace policies; provision of canteen food; and support from family members, caregivers and peers with childcare.

Conclusions: This review highlighted a paucity of literature investigating the effect of workplace-based nutrition interventions on nutrition outcomes, particularly for nutrition-sensitive interventions. The limited evidence suggests that the workplace could be considered as a suitable avenue to tackle multiple forms of malnutrition among women and their offspring providing key barriers to good nutrition in the workplace are addressed.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: nutrition interventions, workplace, women, offspring, low- and middle-income countries

PAB(T6)-138

Fresh large fish are commonly consumed among women in Nigeria, but dried small fish are the richest in iron, zinc, calcium, and vitamin B-12

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Background and objectives: Fish is the most consumed of the animal-source foods among vulnerable populations in Nigeria, though little is known about the categories of fish consumption. Fish is generally presented as a homogenous category in dietary surveys; however, the category of 'fish' varies widely in nutrient composition, based on the form consumed, and the physical characteristics of the fish. Our aim was to compare the nutrient composition and the consumption of different categories of fish among Nigerian women.

Methods: Fish intakes were obtained from a survey of 693 women of reproductive age in August – October of 2019 across nine states in Nigeria, where women were asked qualitatively about their fish consumption in the previous 24 hours. The reported fish were sorted into the following categories: fresh large fish, fresh small fish (less than 25 cm at maturity), fresh shellfish, brackish/marine fish, freshwater fish, dried shellfish, dried large fish, and dried small fish. The average iron, zinc, calcium, and vitamins A and B-12 composition of a 25-gram serving was calculated for each category. The nutrient composition of the fish categories was an average based on nutrient composition data from FishBase and FAO INFOODS.

Results: The most consumed category of fish was large fresh fish, with 70% of women reporting consumption in the previous day. Few women (1%) reported consuming dried small fish, which was also the most nutrient-dense of all the fish categories. 25 grams of dried small fish fulfilled 41% of the daily recommended nutrient intake (RNI) of iron for women, 51% of the zinc RNI, 70% of the RNI for calcium, and 204% of the RNI for vitamin B-12. Dried large fish were the second most nutrient-dense and were reported by 19% of women the day prior, while dried crayfish were the third most nutrient-dense; they were consumed by 8% of women the day prior.

Conclusions: Large fish make up an important component of the Nigerian food supply. However, increased domestic production, processing, and consumption of small fish and crayfish can improve micronutrient intakes for vulnerable populations, thus reducing the burdens of undernutrition of generations to come.

Keyword: women of reproductive age, diet quality, micronutrient deficiencies, hidden hunger, fish and aquatic foods

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-139

Baseline assessment of knowledge and attitudes towards maternal and infant and young child feeding and nutrition in Cambodian workplaces

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Background: In Cambodia, women are increasingly engaging in the paid labor market, while rates of exclusive breastfeeding and dietary diversity for women are declining. Workplace lactation support programs may enable employees to continue breastfeeding, while providing a platform for nutrition and health information. Elsewhere, such programs have increased employee productivity and workplace satisfaction while decreasing absenteeism and health insurance costs. Helen Keller Intl is developing workplace nutrition guidelines and supporting 26 workplaces (factories, banks, and government offices) to establish lactation support programs. Here, we present baseline results collected prior to project implementation.

Methodology: Interviewers administered questionnaires to 648 participants in eight workplaces: 308 women employees with children <12 months ('mothers'), 321 other employees (107 men, 214 women), and 26 managers (10 men, 16 women). The survey assessed infant and young child feeding (IYCF) and women's nutrition practices (mothers only), and knowledge and attitudes related to breastfeeding and current labor laws (all participants).

Results: The mean (SD) age of mothers' infants was 7.5 (2.8) months. Three quarters (75%) of women reported feeling comfortable taking lactation breaks during work hours, and 81% believed a workplace lactation room would be useful. Managers and other employees reported being supportive of breastfeeding staff or co-workers: (93% other employees, 88% managers). While 69% of managers believed human milk was the ideal food for infants, 19% reported that infant formula and human milk were equally good (compared with 84% and 4%, respectively, among women; and 86% and 7% among other employees, respectively). Two thirds (63%) of mothers met the minimum dietary diversity for women. Although 89% of children <12 months reached the minimum meal frequency, only 41% met the minimum dietary diversity score (MDD), and 36% had a minimum acceptable diet (MAD).

Conclusion: Both workers and managers self-report strong support for breastfeeding employees, but managers show less understanding and support of breastfeeding at work. Children of mother employees are not meeting standard MDD and MAD indicators, indicating higher risk of malnutrition. A follow-up assessment will be conducted after 12 months to assess changes related to the intervention.

Keyword: Lactation rooms, Maternal nutrition, Infant nutrition, Workplace nutrition support, Breastfeeding

Conflict of Interest Disclosure: The authors have no conflicts to disclose.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Further Collaborators: Funding through Deutsche Gesellschafts für International Zusammenarbeit (GIZ) and Canadian Social Sciences and Humanities Research Council.

PAB(T6)-140
Nutrient profiling and food prices: the cost of choosing healthier packaged foods

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Background and objectives: Unhealthy diets, as characterized by high intakes of nutrients of public health concern, are one of the leading modifiable risk factors for the prevention of non-communicable diseases. Nutrient profiling (NP) is a tool to help classify foods according to their healthfulness score, based on comprehensive nutritional composition criteria. Price is an important determinant of food choice, however, previous research on the relationship between food healthfulness and price has focused on single nutrients of public health concern. Therefore, the objective of this study was to assess the relationship between the healthfulness score of a food product in relation to price.

Method: Using the University of Toronto Food Label Information Program (FLIP) database 2020 (n=17,453), the nutritional scores for packaged foods and beverages were derived using the Food Standards of Australia and New Zealand (FSANZ) NP system, ranging from -15 (most healthy) to 40 (less healthy) and categorized by Health Canada's Table of Reference Amounts. FSANZ is a validated NP system, that calculates a summary score based on the amount of nutrients to limit and components to encourage in a food. Generalized linear models were used to assess the association between FSANZ score and food price, adjusted for container size, brand and store.

Results: The FSANZ healthfulness score was not consistently related to price. One score increase in FSANZ (less healthy) was associated with higher price ($p<0.05$) for dairy products ($0.11), beverages ($0.08), soups ($0.05), bakery products ($0.04) and vegetables ($0.04). However, negative associations were observed for snacks ($0.04), meat and poultry ($0.04), fruits and fruits juices ($0.07) and legumes ($0.12), where healthier products were higher in price ($p<0.05$).

Conclusions: Our findings show that healthier products were not consistently more expensive than less healthy products, however, for some food categories they may be. This study provides a comprehensive estimate of the relationship between nutritional composition and the price of foods in the Canadian food supply. It can also serve as the baseline from which to evaluate the impact of the key national food policies aimed at improving the nutritional quality of food on price in the future.

Keyword: Nutrient Profiling System, Food Price, Food Composition Database, Nutritional Composition, Food Labels

PAB(T6)-141
Changes over 11 years in vitamin D and sun exposure knowledge, attitudes and behaviours of parents of young children in New Zealand

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Background and Objectives Vitamin D deficiency can have serious health implications for infants and young children. Therefore, parents' knowledge about vitamin D and sun exposure is important to ensure optimal vitamin D status during childhood. In 2013 the New Zealand (NZ) Ministry of Health (MoH) released a consensus statement on vitamin D supplementation and sun exposure during pregnancy, infancy and childhood. The aim was to investigate change over time in the knowledge, attitudes and behaviours of New Zealand parents on vitamin D and sun exposure, and identify sources of information. **Methods** This ecological study recruited parents of infants and young children throughout NZ at two time points - 2009 and 2021 to compare knowledge, attitudes and behaviours, and assess the impact of the NZ MoH statements. An online questionnaire was administered to parents. Inclusion criteria included: youngest child ≦5 years, living in NZ, and understanding written English. **Results** The analysis included parents (2009 N=8,032, 2021 N=1,802) of children ≦5 years. Two thirds (63.1%, 61.3%) identified the role of vitamin D in bone health, awareness of its role in immunity increased in 2021 (29.1% vs. 48.2%). Most parents lacked knowledge of high-risk factors for deficiency, including exclusive breastfeeding (98.1, 95.1%) and darker skin colour (92.9%, 77.5%). Health professionals were not the main source of information on supplementation and sun exposure (15.8%, 24.8%) and low rates of advice were reported. Health professionals or the MoH (60.2%) were the preferred source of information on vitamin D, followed by the media, including social media (24.5%). Safe sun exposure practices were followed during the summer, with concerns about skin cancer high (86.5%, 83.3%). Additionally, 72.4% and 78.4% found vitamin D and sun exposure recommendations confusing because of skin cancer prevention messages. **Conclusion** Overall, the impact of the MoH statements and subsequent public health messaging on parents' knowledge has been minimal. To ensure public health information is communicated effectively to parents, the MoH and health professionals could utilise emerging tools, including social media, to improve parents' knowledge.

Keyword: vitamin D, sun exposure, parents, knowledge

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-142

Recurrent flooding and household diet quantity in Central Java, Indonesia 1988-2015

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Background and objectives: Increasing flooding events in Central Java are impacting food availability through direct losses to agricultural crops, but it is not well-understood how recurrent floods are affecting diet-related aspects of food security at the household level. We evaluate how recurrent flooding has impacted household diet quantity over a 20-year span in Central Java.

Methods: The Indonesian Family Life Survey (IFLS) is a longitudinal household economic and health survey of the Indonesian population with 5 waves: 1993, 1997, 2000, 2007, 2014. We use IFLS to measure diet quantity through household food expenditure share (HFES) based on the Data4Diets framework using monthly aggregates from the consumption and expenditure module. Information pertaining to floods was collected for IFLS waves 4 and 5, covering a 10-year time span only. We use an objective measure of flood exposure at the sub-district level using flood monitoring data. We examine the relationship between floods and HFES using generalized linear mixed-effects models.

Results: Across Central Java, IFLS includes a total of 828 households appearing in all 5 waves and 1,121 households, containing a target member from a previous wave. From waves 1 to 5 HFES was 60%, 59%, 61%, 57%, and 53%, respectively. In waves 4 and 5, 37% and 44% of households, respectively, reported being affected by flood in the past 5 years. Data analysis is ongoing.

Conclusions: Objective measures (along with their risk misclassification) are needed to quantify household exposure to floods. A deeper understanding of how flood impacts household physical and economic food access should guide mitigation, planning, and adaptation in areas vulnerable to recurring flooding events.

Keyword: Food Security, Natural Disasters, Climate Change, Indonesia

Conflict of Interest Disclosure: None

Further Collaborators: Dr. Aris Ismanto, Diponegoro University

PAB(T6)-143

The different pathway to stunting among Under Five Children in Indonesia based on Basic Health Survey 2013 and 2018

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Background and objectives: Stunting is a growth failure among children with multi causal. It is important to identify what are the factors influence it and how did stunting occur with some factors inter-correlated. The study objective was analysed the pathway of possible factors affecting stunting among children under five years old based on national data from Indonesian Basic Health Survey (BHS) 2013 and 2018.

Methods: A study using secondary data from the Indonesia Basic Health Survey year 2013 and 2018. The samples size are 10,209 maternal-child paired data from BHS 2013 and 9,315 paired data form BHS 2018. Pathway of some factors affecting stunting occurrence was modelling using the theoretical framework from The Lancet 2013. Path analysis using partial least squares structural equation modelling (SmartPLS) was used to explain the pathway of stunting. Significant value is showed by T value > 1.96.

Results: Based on path analysis, it shows that the pathway of some factors affecting child stunting are different between data 2013 and 2018. In year 2013 stunting was significantly affected by birth size (T value=9.78) (low birthweight, neonatal stunting), as well as the diseases factors (T=2.48). In 2018, despite of birth size influence stunting (T=8,75), but diseases factors do not influence stunting (T=1.57). The consistent pathway between two datasets, that maternal factor affects access of health services (T=8.78 and T=4.86), then affect the hygiene & sanitation practices (T=2.11 and T=2.07). Maternal factor did not affect birth size (T=0.28 and T=1.77). In 2013, Socio-economic factor affects stunting indirectly through maternal factor (13.86) and hygiene sanitation (T=23.76), it consistent in 2018 with T value of 18.82 and 17.96, respectively.

Conclusion: There are different pathway of factors affecting stunting between two dataset of basic health survey 2013 and 2018, particularly diseases factor and practice of breast feeding, but the consistent factors are birth size, maternal factors, and socio-economic factors.

Keyword: Stunting , Indonesian basic health survey, path analysis

Conflict of Interest Disclosure: We declare that no conflicts of interest

Further Collaborators: Asian Development Bank

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-144

User characteristics of healthcare applications among middle-aged and older Japanese adults: a special focus on nutrition applications

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Background and objectives: Healthcare applications (apps) are increasingly expected to maintain and improve health status among middle-aged and older adults. However, the prevalence and characteristics of the usage of the apps remain unclear among the middle-aged and older populations. These knowledge gaps are evident in apps for recording nutritional intake and supporting healthy eating (nutrition apps), providing nutritional knowledge and expert advice on dietary habits. Therefore, this study aimed to clarify the characteristics of users of health apps, focusing on nutrition apps.

Methods: We conducted an internet questionnaire survey on registrants of a research company. The target population was divided evenly by sex and age, in their 40s, 50s, 60s, and 70s, for 6,000 respondents in the metropolitan area. From 243,529 registrants who matched the sex and age groups in the registered information, 16,136 were randomly selected and asked to participate in the survey by e-mail, and responses to the survey questionnaire were obtained. Questionnaire items included sociodemographic, psychological, and physical characteristics, healthcare apps usage, and health-related behaviors. Respondents were categorized based on the healthcare app usage: nutrition apps users, non-nutrition healthcare apps users, and never users.

Results: Of the 6,000 respondents, 5,933 (aged 40-79 years, mean age 59.3 years, SD=10.8) provided valid responses, comprising 252 (4.3%) nutrition apps users, 1,555 (26.2%) non-nutrition healthcare apps users, and 4,126 (69.5%) never users. Multinomial logistic regression models showed that younger age, higher health literacy, currently working, more comorbidities, better subjective financial status, regular exercise habits, non-smoking, and non-underweight were significantly associated with being the non-nutrition healthcare apps compared to the never users. In addition to these factors, having frequent balanced meals and frequent home-meal replacements were associated factors with being the nutrition apps users.

Conclusions: We found that healthcare apps users tended to have high health consciousness and practice behaviors. Furthermore, those who used nutrition apps tended to have good dietary habits. Although careful attention should be paid to causality, nutrition apps may contribute to maintaining good nutritional status among middle-aged and older adults.

Keyword: healthcare applications, nutrition applications, user characteristics, middle-aged and older adults, health consciousness

PAB(T6)-145

Determining the cut off values for hypovitaminosis D among pregnant mothers in Colombo District-Sri Lanka

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Background and objectives: Vitamin D testing have exponentially increased in recent years. The relevance of vitamin D deficiency on non-skeletal health is still under debate. Recent observational data have suggested that 62.9% of Sri Lanka pregnant women are vitamin D deficient (25-hydroxyvitamin D (25-OHD) <20ng/ml). The relevance of this widespread deficiency and necessity for supplementation has been questioned. There is no consensus on the cut-off values for 25-OHD) levels. Thus, we aimed to determine (25-OHD) cut-off values for pregnant mothers in Western Sri Lanka.

Methods: We recruited 393 healthy pregnant mothers in 3rd trimester from primary healthcare units in the Colombo District. Multistage, stratified random sampling was used for recruitment. Venous blood sample was collected for analysis of serum 25(OH)D and parathyroid hormone (PTH). Chemiluminescent immunoassay (CLIA) was used to measure the 25OHD levels. Deficiency cut-off value with highest sensitivity and specificity was obtained using receiver operating characteristic (ROC) curve analysis based on PTH level.

Results: 25(OH)D concentrations were inversely correlated with PTH levels (Spearman's r= -0.220, p=0.000). Serum 25(OH)D cutoff point was 8.1 ng/mL based on PTH level (66.5 pg/mL). By using this cutoff value, the prevalence of vitamin D deficiency was 4.1% in this study population of healthy pregnant women with an accuracy rate of 95.6% and corresponding sensitivity, specificity, and AUC of 0.961, 0.667 and 0.933 respectively.

Conclusions: Our study found that the 25(OH)D cutoff value based on PTH is 8.1ng/mL for healthy pregnant women on chemiluminescence technology.

Keyword: pregnancy, infants, hypovitaminosis D, Cut off, Sri Lanka

Conflict of Interest Disclosure: Authors have no conflict of interest to report

Further Collaborators: Not applicable

PAB(T6)-146

Field experience in developing an action plan to integrate early detection and treatment of wasting services in Ethiopia

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Background and objectives: According to the Ethiopian Mini-EDHS 2019, 37% of children under age five are stunted while 7% are wasted. In 2021, the Ethiopian Federal Ministry of Health began a journey to develop a national plan to further integrate wasting treatment into routine primary healthcare services across all health system building blocks. Goals are to increase coverage of wasting services, increase efficiency of service delivery and ensure financial sustainability.

Methods: A six-step process was utilized to develop the wasting integration action plan: 1) **establish the process** to develop a work plan and decide who to involve in the process; 2) **articulate intended aims** of the integration and end goals; 3) **take stock of the current situation** to identify wasting program constraints and opportunities within the broader health system for integration; 4) **identify possible integration actions** based on the findings; 5) **assess integration actions** for feasibility, benefits and risks to develop recommendations; and 6) **decide on a way forward** to present options and recommendations to senior officials for decision.

Results: Major constraints and enablers to achieving wasting integration program goals were identified across all health system components, including limitations in accountability, uncertain sustainability of wasting services due to continued reliance on external partners, insufficient screening and early detection of child wasting, low treatment coverage for moderate wasting services, substandard quality of wasting treatment services, limited capacity of health staff, limited availability of high-quality wasting data for routine monitoring, gaps in use of wasting data in health sector decision-making, insufficient funding, under-prioritization of RUTF as an essential commodity, and inefficient RUTF Supply chain. Based on the findings, a wasting integration action plan was developed.

Conclusions:

-Stakeholders have a wealth of knowledge and experiences related to child wasting and their effective engagement helped for effective action plan development.

-Assessment is critical to identify the specific barriers to wasting integration in each context and develop effective integration action plan.

-Positioning wasting integration across all the six health system components helps to address integration issues in a more comprehensive way.

Keyword: Integration of wasting treatment

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-147

Food and nutrition security amongst garment female workers in Myanmar: Evidence from a remote longitudinal survey conducted during the COVID-19 pandemic and political crisis

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Background and objectives: In Myanmar, the ready-made garment (RMG) sector has heavily been hit by the COVID-19 pandemic and the current political crisis. Women in the RMG factories are highly vulnerable to poor diets and malnutrition in Asia. The aim of this study was to evaluate, during the health and political crisis, the impact of a nutrition-sensitive intervention (i.e., unconditional cash transfer combined with a targeted social and behaviour change component) on food and nutrition security amongst a sample of garment female workers in urban Myanmar. **Methods:** We conducted a remote longitudinal study of women of reproductive age in May/June 2021 (baseline; *n=800*) and December 2021/January 2022 (endline; *n=678*). The Minimum Dietary Diversity (MDD-W) was generated using reported qualitative intakes of foods and beverages during the past 24-h. Food insecurity (FI) at the household level was measured using the Food Insecurity Experience Scale (FIES). Changes in key indicators were assessed by comparing endline and baseline data. Multivariable regression analyses were performed to assess the relationship between the amount of cash transfer and key outcomes at endline. **Results:** Moderate or severe household FI decreased (38.3% vs. 36.5%; p<0.001) whilst severe FI remained stable (10.1% vs. 8.9%; p=0.13) over time. The proportion of women eating a quality diet remained low over time and was not significantly different between the two time points (27.1% vs. 31.8%; p=0.10). The consumption of sugar-sweetened beverages (SSB) decreased (25.6% vs. 17.7%; p=0.008). Consumption of eggs and/or flesh foods was high with no noticeable differences between the two time points (84.5% vs. 87.2%; p=0.66). The proportion of women consuming zero fruit or vegetable decreased significantly (15.7% to 9.9%; p=0.007). The amount of cash received was positively associated with fruit (OR=1.14 [0.97; 1.33]; p=0.10) and SSB (OR=1.14 [0.97; 1.33]; p=0.12) consumption, although the results are not statistically significant. **Conclusions:** The social safety net might have prevented further deterioration of indicators which was anticipated given the health and political crisis in Myanmar. Given the positive association between cash transfer and SSB consumption, the use of conditional cash transfers should be considered to prevent malnutrition.

Keyword: Social safety net, diet, food insecurity, women of reproductive age, Myanmar

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-149
Measuring adherence to sustainable healthy diets: A scoping review of diet quality metrics

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Background and objectives: Addressing unhealthy and unsustainable diets is a key priority on the agendas of governments, academia, and civil society worldwide. Despite the significance of the topic, it is unclear how dietary metrics used to monitor the quality of diets account for all components of sustainable healthy diets. This scoping review aims to explore how principles of sustainable healthy diets are considered in global diet quality metrics used worldwide.

Methods: A scoping electronic search comprised a hand-search of metrics included in relevant reviews of the field; and due to the novelty of the topic, additional sustainability-focused metrics were identified through an electronic systematic search. Food-based 'a priori' dietary metrics developed to assess diet quality among free-living, healthy children and/or adults at individual or household level were included. The 16 guiding principles to achieve sustainable healthy diets developed by the Food and Agriculture Organization of the United Nations and the World Health Organisation in 2019 were used as a framework to assess the metrics.

Results: A total of 48 diet quality metrics were assessed. The analysis revealed a strong alignment of the metrics with health-related guiding principles (particularly Principles 2 to 4), but a critically weak alignment with principles related to environmental impact and sociocultural aspects (except Principle 14).

Conclusions: No existing dietary metric captures all components of sustainable healthy diets. Notably, the significance of ultra-processing, environmental and cultural aspects of diets is generally understated. These results highlight the importance of revising current dietary recommendations, especially to include emerging topics.

Keyword: Sustainable healthy diets, Health, Sustainability, Diet quality, Metrics

Conflict of Interest Disclosure: None

PAB(T6)-151
A critical analysis of the relevance of evidence used to inform nutrition policy recommendations in Australia

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Background and objectives: Nutrition policy-making is a scientific and political process that needs to navigate contested views towards the causes of and the solutions to public health nutrition problems and consequently, to determine what constitutes quality evidence to inform policies. Often, evidence relevance is not considered in assessing evidence quality, which raises questions about whether the design of evidence-informed nutrition policies is always fit-for-purpose for developing the safest and most effective of the policy options that might be available. This study aimed to identify the most recent nutrition policy recommendations in Australia and critically analyse the relevance of the evidence synthesis and translation processes that informed their developments.

Methods: A framework underpinned by the principles of ecological and evolutionary theories, and which was designed for guiding the selection of fit-for-purpose evidence synthesis and translation processes for promoting healthy and sustainable diets, was used in this study. Data on policy recommendations were collected from a content analysis of the 2021 Australian National Health Preventive Strategy (ANHPS) and 2022 Australian National Obesity Prevention Strategy (ANOPS). The relevance of the evidence synthesis and translation processes used in the policy decision-making process was analysed by comparing their alignment with the principles outlined in the fit-for-purpose guiding framework.

Results: The content analysis of the ANHPS and ANOPS revealed that recommendations used for the development of nutrition policy actions were mostly around front-of-pack labelling, food taxation, and food marketing restrictions to children. Evidence relevance was not found to be an explicit criterion considered in the evidence synthesis and translation processes that were used to inform the making of the assessed policy recommendations. Thus, the resulting design of the recommended policy actions did not align closely with the guidance provided in the fit-for-purpose framework.

Conclusions: These preliminary findings show that evidence relevance is being significantly overlooked in decision-making processes when developing nutrition policy recommendations in Australia. These findings raise questions about whether the current nutrition policy recommendations in Australia are necessarily the best fit among available options to achieve preventive health and obesity prevention purposes.

Keyword: evidence relevance, nutrition policy-making, worldviews, fit-for-purpose

Conflict of Interest Disclosure: The authors declare that there is no conflict of interest.

Further Collaborators: No further collaborators other than what I entered in "Authors" section.

PAB(T6)-152

Reducing Food waste: Changing Awareness and Behavior in Elementary School Students, Parents, and Teachers

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Background and purpose: The United Nations has set Sustainable Development Goals (SDGs), and efforts to implement them have begun in various countries and regions regarding food waste, poverty, and deterioration of the global environment. In Japan, foods that can still be eaten but are often thrown away. In response to this situation, we conducted a survey for elementary school students, parents, and teachers regarding their awareness and behavior regarding food waste reduction and created teaching materials to modify behavior and attitudes.

Method: Target: Elementary school students, parents and teachers Subjects: 57 children, 38 parents, 15 teachers in 2020 56 children, 34 parents, 11 teachers in 2021 Timing: June 2020 – July 2021 The survey was anonymous and consisted of a self-administered questionnaire. Excel statistics (BellCurve for Excel) Ver.2.21 (Social Information Service Co. Ltd.) was used to analyze the results.

Results: The percentage of children who answered that they "know the word food waste" increased from 36.8% to 78.6%. Responses for "it is not good to leave food uneaten" increased from 59.6% to 76.8%. We created a booklet to encourage students to think about sustainable development goals on a global scale using a familiar food-related issue, "Let's get rid of *mottainai*. M*ottainai* means wastefulness.

Conclusion: Through hands-on activities such as planting rice, harvesting rice, and planting sweet potato seedlings, the children learned that making food takes more time and effort than they had imagined. They developed their understanding and attitudes through sharing experiences with friends and local people and seeing how vegetables and rice grow on a daily basis. As a result, they developed a feeling of gratitude and appreciation for the people that produce and process food. This will continue to increase. We also expect that the amount of leftover food and wasted food will be reduced. Survey results confirmed that the knowledge about reducing food waste increased and awareness and behavior changed in the desired direction due to aa continuous process of instruction and activities. The booklet we created, will be used for future instruction in primary schools on reducing food waste.

Keyword: SDGs, Food Waste Reduction, Food education, Attitude of appreciation and gratefulness

PAB(T6)-153

Knowledge and skills to counsel on infant and young child feeding during and after illness among community health volunteers in Turkana County, Kenya

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Background and objectives: Appropriate infant and young child feeding (IYCF) for a sick child includes continuing to feed during illness and feeding extra after illness. These recommendations are critical to ensure children effectively fight the illness, experience minimum weight loss, and recover quickly. Thus, programs such as integrated community case management (iCCM) include IYCF for sick children. In Kenya, community health volunteers (CHVs) implement iCCM, which has a significant focus on disease treatment. However, it is unclear what level of counseling CHVs provide to support IYCF of sick children. The objective of this study was to examine the knowledge and skills CHVs have to counsel caregivers on IYCF during and after illness.

Methods: In Kenya, we purposively selected two sub-counties within Turkana County, Loima, and Turkana Central. We conducted 36 in depth interviews with national, county, and sub-county health managers; community health extension workers; community health committee members; CHVs, and mothers of children under 5. We also conducted four focus group discussions with CHVs and mothers. We reviewed the CHV iCCM training manual, job aid, and supervision checklist to assess whether these materials provide/assess the knowledge and skills for counseling on feeding during and after illness. **Results:** Mothers reported that messages on feeding a sick child from CHVs were on continuing to feed during illness with much of the focus on giving fruits (e.g., banana, oranges, and mangoes). CHVs confirmed this finding. Only one mother shared that her CHV told her to continue feeding solids while also breastfeeding. Neither mothers nor CHVs described how to feed during the recuperative period after illness. The iCCM training manual, job aid, and supervision checklist for CHVs provides/assesses knowledge on how to feed solids during illness, but does not cover age-appropriate information on feeding during and after illness. Further, the manual does not give CHVs an opportunity to practice counseling on sick child feeding.

Conclusions: The limited content of sick child feeding in iCCM contributed to poor CHV counseling of mothers on age-appropriate IYCF during and after illness. The Government of Kenya should consider revising the sick child feeding component of iCCM.

Keyword: sick child feeding, counseling, community health volunteers, Kenya, iCCM

Conflict of Interest Disclosure: NA

PAB(T6)-154

Night Eating Syndrome and its association with lifestyle characteristics among a selected group of working adults in Kuala Lumpur, Malaysia

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Background and Objectives: Night eating syndrome (NES) is a disordered eating behaviour characterised by hyperphagia at night, often accompanied by a sleep disturbance. It impacts the healthy lifestyle of the individuals. NES is gradually gaining attention as it is a growing global concern due to its clinical implications. This study aims to determine the impact of NES on the lifestyle characteristics of working adults.

Methods: This is a cross-sectional study with 217 participants, who were recruited from a selected inbound call centre at Kuala Lumpur, Malaysia. A simple random sampling was carried out and the employees who met the selection criteria were selected for this study. A self-administered night eating questionnaire (NEQ) was used to determine the night eating syndrome among the employees. Simple Lifestyle indicator questionnaire (SLIQ) was used to assess their lifestyle characteristics.

Results: The mean age of the participants was 24.1± 6.0 years. About 12% of the inbound call centre employees who had scored >25 in NEQ, indicates the presence of NES. Majority (57.1%) of the employees reported an unsatisfactory level of dietary intake. About 27.6% of them were smokers and nearly three quarters (72.4%) of the employees did not consume alcohol. Life stress was reported by 79.3% of the employees. Univariate analysis showed that the employees with satisfactory level of exercise were more prone to have NES as compared to their counterparts with unsatisfactory level of exercise (OR = 4.410, 95% CI = 1.464-13.288, p = 0.005]. The employees with satisfactory level of diet intake were less likely to have NES when compared to those with unsatisfactory level of diet intake (OR = 1.026, 95% CI = 0.448-2.351, p = 0.952]. Alcohol intakes (p = 0.705), smoking habits (p = 0.705) and presence of life stresses (p = 0.840) were not associated with NES.

Conclusion: The prevalence of NES among this group of working adults is very high. Unhealthy food choices and late-night eating leads to unhealthy weight gain, resulting in increased prevalence of overweight and obesity. Early screening and nutrition education could reverse the eating behaviour of employees to manage their NES, resulting in improved health outcomes.

Keyword: Night eating syndrome, , , , prevalence, working adults, life style

Conflict of Interest Disclosure No conflicts of Interest that needs to be disclosed

Further Collaborators: None

PAB(T6)-155

Exploring the factors affecting indigenous food consumption in *Ho* community of Jharkhand, India

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Background and Objectives: *Ho* indigenous community of Jharkhand, has access to diverse indigenous food (IF) systems, characterized by agroforestry and traditional ecological knowledge. However, a paradox exists between access to diverse food sources and poor utilization, resulting in high levels of malnutrition in the community. A study was conducted to explore the factors affecting IF consumption in *Ho* community of Jharkhand, India.

Methods: A qualitative study with 7 focus group discussions (FGDs) and 2 in-depth interviews were conducted in September 2021 across 9 randomly selected villages of West Singhbhum district, Jharkhand. FGD participants included adult men, women and elders, who were identified using snowball sampling, while interviews were conducted with village leaders and/or health and nutrition workers. All qualitative inquiries were recorded, transcribed and translated. The data were coded using deductive approach; similar codes were identified and merged to produce main themes and sub-themes related to the research question. Data analysis was done in Atlas.ti version 7.5.7.

Results: Qualitative enquiries revealed that *Ho* community accesses IFs from diverse natural food environments like agricultural lands, forests, water bodies and local markets. The facilitators associated with IF access and consumption included their i) desirable taste, ii) perceived satiety, iii) ethnomedicinal properties, iv) socio-cultural value leading to use in special occasions and v) preservation of certain varieties (indigenous leafy vegetables, mushrooms and small fishes) for consumption during lean periods. Additionally, factors promoting indigenous crop production included low resource requirements, climate change resilience and suitability of indigenous seeds for prolonged storage. Barriers of IF production, access and consumption included i) high opportunity cost of accessing foods from wild habitats ii) lack of awareness and intergenerational knowledge gap about IFs from wild habitats, iii) higher crop yields of hybrid seeds and iv) climate variability impacts resulting in reduced IF availability and production.

Conclusion: Culture and context-sensitive policies and interventions promoting IFs valued by the communities should be given due attention. Barriers need to be addressed through strategies promoting access to indigenous seeds, climate-specific agronomic support, and incorporation of IFs in government supplementary feeding programs

Keyword: Indigenous foods, Indigenous communities, Ho tribe, Natural food environment

Conflict of Interest Disclosure: The authors declare no conflict of interest.

Further Collaborators: NA

PAB(T6)-156

Are popular books on diet and health written based on scientific evidence?: A comparison of references cited in books between the US and Japan

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Background and objectives: There is a tendency among the general population to obtain information on diet and health from popular books. However, the scientific accuracy of the information presented in them is not necessarily guaranteed, making them often unreliable. References, the sources supporting the presented information, allow for the judgment of information reliability. Although the presence of references does not fully guarantee that the information is trustworthy, it is considered a minimum requirement of reliable information. Therefore, we examined the references in popular books on diet and health sold in the US and Japan.

Methods: We selected 100 books in each country based on the ranking order among diet and health categories in online bookstores. We excluded books not related to diet or health as well as books for professionals, textbooks, magazines, and calorie guides. The main themes of books were categorized using the summaries available at the bookstores. We analyzed the entirety of each book for the references to examine where the references were cited (text or figures and tables) and the number of references.

Results: The most frequent main themes were general health (US, 31%, Japan, 38%), recipes (US, 44%, Japan, 31%), and weight loss (US, 13%, Japan, 11%). In both countries, 66 books had references. Among these, all books had references on the text (not only on figures and tables) in the US, while this was true for 73% of books in Japan. Furthermore, the books from the US cited many more references than those from Japan. Thirty-seven books cited more than 100 references in the US, but only five books cited more than 100 references in Japan.

Conclusions: The proportion of the books with references was similar in the US and Japan, but whether the references were cited in the text and the number of references differed between the two countries. These may reflect the different perceptions of referencing to make presented information trustworthy. The quality of the referencing is under investigation.

Keyword: evidence-based nutrition, reference source, reliable information, books, health

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PAB(T6)-157

Availability of healthy and unhealthy foods in modern retail outlets located in selected districts of Greater Accra region, Ghana.

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Background and objective: Availability of unhealthy (nutritionally poor) foods can influence preference, purchasing and consumption of such foods. This study determined the healthiness of foods sold at modern retail outlets- supermarkets and mini-marts in the Greater Accra Region of Ghana.

Methods: All modern retail outlets located in six districts of Greater Accra were eligible. Permanent structured outlets with floor area <200m^2 were categorised as mini-marts; and those ≧200m^2 as supermarkets. Shelf length of all available foods were measured. Healthiness of food was determined using two criteria - the NOVA classification and energy density of foods. Thus, ultra-processed foods or food items with >225kcal/100 g were classified as unhealthy. The ratio of the area occupied by unhealthy to healthy foods was used to determine the healthiness of modern retail outlets.

Results: Of 67 retail outlets assessed, 86.6% were mini-marts. 85.0% of the total shelf area was occupied by foods categorized as unhealthy. Refined grains/grain products were the most available, occupying 30.0% of the total food shelf space, followed by sugar-sweetened beverages (20.1% of total shelf space). The least available food group–unprocessed staples, and occupied 0.1% of the total food shelf space. About two-thirds of food products available (n =3952) were ultra-processed. Across retail outlets, the ratio of ultra-processed-to-unprocessed foods ranged from 3 to 7 with an average (SD) of 5(2). Thus, for every healthy food, there were five ultra-processed ones in the studied retail outlets.

Conclusion: This study reveals widespread availability of ultra-processed foods in modern retail outlets within the selected districts. Towards a healthier food retail environment, public health and food regulators, in partnership with other stakeholders need to institute measures that improve availability of healthy foods within supermarkets and mini-marts.

Keyword: Modern retail outlet, Healthy food, Unhealthy food, Ultra-processed food, Ghana

Conflict of Interest Disclosure: No conflict of interest

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-158
Food groups consumption in Japanese schoolchildren with a low diet cost and good nutrient intake

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Background and Objectives: High diet quality is associated with high monetary cost. To achieve both a high-quality diet and low dietary cost, this study aimed to investigate the characteristics of food groups consumed by schoolchildren who have a low diet cost and good nutrient intake.

Methods: We analyzed dietary records with photographs of 402 fifth grade students (195 boys, 48.5%) aged 10-11 years from nine public elementary schools in two prefectures in eastern Japan. Records were from 4 days (2 with school lunch and 2 without). Diet cost per day was calculated using the prices in the 2013 National Retail Price Survey. School lunch costs were set at 241.5 Japanese yen (the national average school lunch fee per meal). Adequacy of nutrient intake was assessed by the number of nutrients meeting the dietary reference intake values among 12 nutrients (DRI score). Children with a low diet cost (≦850 yen/day) were divided into three groups according to the DRI score, and the intake of food groups was compared by using the Jonckheere-Terpstra test.

Results: Median (interquartile range; IQR) of diet cost was 868.9 (751.2-1031.0) yen. There were 185 children (46.0%; 84 boys [45.4%]) with low diet cost who were divided into low (0-3 points, n=40), middle (4-6 points, n=77), and high (7-12 points, n=68) DRI score groups. Comparison of food group intakes among the three groups showed that the high DRI score group consumed higher amounts of green and yellow vegetables, other vegetables, fruits, mushrooms, and eggs ($p < 0.001$, < 0.001, < 0.001, $= 0.021$, and 0.004, respectively), while consuming less meat ($p = 0.010$). In the high DRI score group, intakes of carrots, spinach, cabbage, and onions were high among vegetables and intakes of citrus fruits and apples were high among fruits.

Conclusions: In school children with a low diet cost and good nutrient intake, intakes of vegetables, fruits, mushrooms, and eggs were high. For vegetables, intakes of carrot, spinach, and cabbage may be associated with good nutrient intake in spite of their lower cost.

Keyword: Schoolchildren, Monetary diet cost, Food group intake, Dietary reference intakes

PAB(T6)-159
Content analysis of TV food advertisements targeted to children in the Philippines

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Background and objectives: Exposure to TV food advertisements is considered as a potential factor influencing dietary and food consumption behavior among children. However, there are no policies regulating child-targeted TV food advertisements in the Philippines. Furthermore, there is limited literature that explores the influence of TV food advertisements on the dietary health of Filipino children in which overweight and obesity are prevalent. This study aims to (1) assess the frequency and level of exposure of children to food promotions and their content through televisions, (2) evaluate marketing practices, such as the use of licensed characters or celebrities from movies or popular children's television programs, use of humor, use of premiums or competitions, use of healthy food claim, and depiction of physical activity, which are known to affect children's perceptions of advertised product. **Methods:** Therefore, this study conducted an exploratory content analysis of TV food advertisements aired on the most popular channels for Filipino children aged 2 to 12 (GMA, GNTV, and TV5). Data were collected from January to April 2021 through manual recording of aired advertisements which were then monitored using a categorical sampling design. A thematic analysis of food ads was also conducted to identify persuasive techniques and elements used in food ads. **Results:** Findings reveal that the frequency of non-permitted food ads aired per hour is significantly higher than permitted food ads. Additionally, there are more non-permitted food ads aired during peak viewing times that exhibit strong persuasive content. Qualitative themes prevalent in food ads include audio-visual cues, representation of family, depiction of exercising, and emotional appeal. **Conclusions:** This study recommends that TV food ads and child-targeted marketing should be regulated to minimize the advertisement of non-core foods and its effects on children's diets and food choices.

Keyword: Children, food marketing, persuasive techniques, television

Conflict of Interest Disclosure: none

Further Collaborators: none

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-160
Comparative Validity and Reliability of the Temporal Pattern of Dietary Intake (TPOD) Questionnaire

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Background and objectives: Temporal patterns of dietary intake are emerging risk factors for metabolic disorders, as shown in randomized controlled trials and epidemiologic studies. However, there is no convenient tool to assess the usual temporal patterns of dietary intake of people. We developed a questionnaire for epidemiologic assessment of this dietary risk factor.

Methods: The 17-item TPOD questionnaire was developed to capture eating frequency and meal regularity over the last three months. Adult volunteers (n=125) were recruited on a university campus in Taipei, Taiwan. Three (3) non-consecutive 24-hour dietary recalls were collected within about 2 months (45-110 days, median 59 days), where details of time and amount of food intakes in the previous day of interview were collected. In the first- and last-day dietary recall interviews, the pre- and post-test of the TPOD questionnaire were administered, respectively. The interview process was standardized and conducted by trained interviewers. To assess meal regularity, the Chaotic Eating Index and the Meal Regularity Score were constructed using the TOPD questionnaire and the 3-day dietary recall separately. TPOD questionnaire's pre-post reliability was assessed by correlation coefficient between the first- and last-day interview. The comparative validity of TOPD questionnaire was assessed by the correlation between TOPD and 3-day dietary recall.

Results: The average age of the subjects was 22.5 years (SD=2.9), and 58% of them were women. Most of the subjects were students (91.2%). The proportion of subjects reporting always, usually, and rare/never having regular meals were 31%, 43%, and 26%, respectively. The reliability of the eating frequency assessment ranged from 0.63-0.67. The reliability of Chaotic Eating Index based on the TOPD assessment was 0.44-0.48. Comparative validity of the eating frequency showed correlation coefficients ranging between 0.33-0.40. The single meal irregularity question showed a moderate validity (r ranging between 0.31-0.41) compared to the Chaotic Eating Index and Meal Regularity Score assessed by 3-day dietary recalls.

Conclusions: The questionnaire shows values of assessing adults' usual temporal patterns of dietary intakes, and measures the patterns of a longer term (i.e. 3 months) than what food records or dietary recalls could have done.

Keyword: assessment instrument, dietary patterns, meal regularity, meal timing

Conflict of Interest Disclosure: No conflict of interest.

PAB(T6)-161
Association between food subsistence level and dietary intake among farmers in peri-urban Kenya

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Background and objectives: Kenya has experienced the double burden of malnutrition, such as overweight and micronutrient deficiencies among women. In vegetable growing areas, promoting subsistence may increase dietary quality through vegetable consumption, but increased subsistence may affect household incomes, worsening overall diet quality. This study examined the impact of food subsistence levels (FSL) on dietary intake.

Methods: Women farmers aged 20-56 years (n=64) in Kabete sub-county Kiambu County in Central Kenya, a peri-urban vegetable-growing area, participated in this cross-sectional study. Face-to-face interviews were conducted on participants' dietary intake (two days-24-hour recalls), characteristics and agricultural production. We defined the proportion of own-produced food in all consumed food excluding condiments and beverages as FSL. Dietary intake was assessed by participants' adherence to Kenyan food pyramid (FP) score (maximum 50), dietary diversity scores (maximum 10), and food group intake. The association of the tertiles of FSL and agricultural production and dietary intake were investigated. Multiple regression analysis was performed with FP score or dietary diversity as dependent variable and FSL and confounders as independent variables.

Results: Average FSL was 39.6±16.3%. The FSL was not associated with household income or agricultural production. Nearly 90% of households cultivated green leafy vegetables (GLVs) in all three groups during the survey. Of the 23 frequently consumed foods, 8 items (variety of GLVs, eggs, pulses, and plantains) were from own-produced (more than 70%) in the high-FSL group, while only 2 items were in the low-FSL group. The FSL tended to be positively associated with intake of GLVs but negatively associated with intake of animal-source foods (ASFs) and other vegetables. The FSL had a significant positive impact on dietary diversity (β=0.300, p=0.013) but not on the FP score.

Conclusions: The FSL was positively associated with dietary diversity but negatively associated with ASFs intake. The lack of a significant association with the FP score may reflect differences in food grouping and inadequate intake. To improve dietary quality, promoting the consumption of own-produced crops and enhancing the availability of healthy foods such as ASFs may be needed. Further large-scale studies are required, including the effects on health status.

Keyword: Food subsistence, Food access, Dietary habit, Dietary diversity, Kenya

PAB(T6)-162

Not the usual subjects: Engaging the non-health sector to enforce the International Code of Marketing of Breast-milk Substitutes in Cambodia

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Background and objectives: In 1981, the World Health Organization established the International Code of Marketing of Breast-milk Substitutes (Code) to restrict promotion and safeguard infant and young child health. In the subsequent four decades, the health sector has primarily been held responsible for enforcement of national Code regulations. The Royal Government of Cambodia enacted the Sub-Decree on Marketing of Products for Infant and Young Child Feeding (SD133) in 2005, adopting many provisions of the Code. SD133 designates four ministries to uphold the law, with the Ministry of Health leading enforcement. However, in recent years the Ministry of Commerce (MOC) has actively embraced Code monitoring in their retail inspection activities, providing a unique example of a non-health body controlling marketing of breastmilk substitutes and protecting breastfeeding.

Methods: MOC officials revised their existing checklists, training materials, procedures, and reporting formats to integrate SD133 monitoring into their routine inspections of retail locations selling breastmilk substitutes. MOC inspectors from all 25 provinces of Cambodia were trained in SD133 monitoring from 2019 to 2022. They conduct monthly inspections at retail locations to identify marketing violations, submitting reports by mobile messaging app. The MOC also ensures the nutrient composition of breastmilk substitutes marketed in Cambodia adhere to global standards through laboratory nutrient content testing and takes actions to hold companies accountable.

Results: In total, 123 provincial-level MOC inspectors were trained and all 25 provincial inspector teams developed work-plans for integrated SD133 monitoring. Inspectors conducted 1,176 monitoring visits to 165 locations between January 2021 and February 2022, with 3,528 reports generated. Inspectors have educated 330 shop owners and issued 1,176 verbal warnings, 36 written warnings, 36 financial penalties, and suspended the sale of 21 products violating SD133. MOC sent 194 unique products for nutrient content testing, finding 12 products non-compliant with global nutrient content standards, leading to a criminal court case.

Conclusions: The MOC has taken full ownership of enforcement of SD133, building a system to monitor breastmilk substitute promotions and ensure product quality through integration with their routine responsibilities. The non-health sector can successfully be engaged to uphold national Code legislation and protect breastfeeding.

Keyword: Breastmilk substitute, policy, monitoring, integration, Cambodia

Conflict of Interest Disclosure: The authors have no conflicts of interest to declare.

PAB(T6)-163

A Study on the Reduction of Simple Urinary Sodium/Potassium Ratio Caused by Potassium Fortification with Foods for the Prevention of Cardiovascular Disease

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Background and Objective: Cardiovascular disease is one of the leading causes of death in Japan. Lowering the urinary sodium(Na)/potassium(K) ratio is effective in preventing hypertension and cardiovascular disease. The sodium/potassium ratio measured by spot urine has been validated in relation to the Na/K ratio from 24-hour urine storage. This study examined the effect of changes in potassium intake from vegetables and fruits, but not salt, on the urinary Na/K ratio.

Methods: The subjects were 8 healthy young people (6 females and 2 males), and the trial lasted 3 weeks during the winter season. Height, weight, and blood pressure were measured. The diets were adjusted based on the data of the same age group in the National Health and Nutrition Examination Survey. This basic diet was used for the first week, a banana equivalent to 400 mg of potassium was added for the second week, and vegetable juice for the third week. The urinary Na/K ratio was measured using a urinary Na/K ratio-measuring device called HEU-001F (OMRON Healthcare Co., Ltd., Kyoto, Japan)

Results: Mean body weight and blood pressure did not differ significantly during the period. The mean urinary Na/K ratio at week 1 was 3.92±0.19, 3.19±0.19 for the addition of banana and 3.14±0.13 for the addition of vegetable juice, showing a significant difference among the three groups ($p<0.01$). Significant urinary Na/K ratio reductions were observed with the addition of banana and vegetable juice compared to the basal diet ($p<0.05$).

Conclusions: In Japan, salt intake has remained high in recent years, while vegetable and fruit intake has declined. The addition of fruits and vegetables and juices with the equivalent to only 400 mg of potassium may help prevent cardiovascular disease.

Keyword: potassium fortified, urinary Sodium/Potassium ratio, vegetables & fruits, cardiovascular disease, prevention

PAB(T6)-164

Correlation Between Behavior In Choosing Instant Noodles, Reading Labels, Family Income, And Nutritional Knowledge On Instant Noodle Consumption Patterns During Distance Learning For Nutrition Student

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Background and Objectives: West Java Province occupies the first position (65.1%) the most frequent consumption of instant noodles (1-6 times/week) and the highest consumption of instant noodles is in the age group 15-19 years (72.74%). The habit of eating frequent instant noodles can increase the risk of poor health (Huh et al, 2017). This study aims to determine the determinants of instant noodle consumption during the Covid-19 pandemic among Nutrition Students at UPN Veterans Jakarta while they were doing distance learning program.

Methods: This study used a cross-sectional design with a sample size of 111 people. The data was taken by filling out an online questionnaire through the google form platform. Data analysis was conducted with Chi Square test (bivariate analysis).

Results: Based on the results of statistical tests there was no relationship between the behavior of reading food labels (p = 0.438), the availability of instant noodles (p = 0.438), nutritional knowledge (p = 0.528) and family income (p = 0.867) on students' eating behavior of instant noodles and there was the relationship between the behavior of choosing instant noodles (p=0.000).

Conclusion: The behavior of eating instant noodles is influenced by various factors. Students who have a positive attitude towards food choices are related to good eating behavior and are beneficial to their health. Parents and environment support are needed to optimize better eating behavior of students.

Keyword: Instant Noodle Consumption, students, the covid 19 pandemics

PAB(T6)-165

Assessment of Nutritional Status of Underweight and Severely Underweight children aged 3 to 5 years old using Nutripacks with Vita Meena Micronutrient Powder (MNP)

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Background and objective: Malnutrition is a problem of public health significance. One form of malnutrition is being underweight where children have low weight-for-age. National survey of Food and Nutrition Research Institute (FNRI) recorded 21.8% of underweight children ages 3 to 5 years old. To help alleviate the prevalence of malnutrition, the Department of Social Welfare and Development (DSWD) conducts Supplementary Feeding Programs (SFP). The COVID-19 pandemic created a situation that posed challenges to nutrition programs like this, and utilizing ready-to-cook food packs with vitamins and minerals was convenient to make sure that the program will continue even in the comforts of the participant's home. Nutri-Foods Ready-to-Cook Food Packs (NutriPacks) with VitaMeena Micronutrient Powder (MNP) is developed by Philippine Nutri-Foods Corporation. This comes in a 50 g pack. Each pack gives 215 kcal of energy and 7.34 g of protein. It also contains 22 vitamins and minerals that provides more than 40% of Recommend Energy and Nutrient Intake (RENI) of children ages 3-5 years old. The main objective of the study is to determine the effectiveness of the NutriPacks+VitaMeena in improving the nutritional status of the children.

Methods: The study involved 334,715 underweight and severely underweight children aged 3-5 years old from Region V and Region IV-A. The children were fed for 120 days with supplementary food, wherein Nutripacks with VitaMeena is served twice to thrice, weekly. The improvement in the nutritional status of children was assessed by comparing their weight for age, based on the Child Growth Standards provided by World Health Organization, before and after the feeding activity.

Results: 64.62% in Region IV-A and 83.32% in Region V were reported to have improvement in nutritional status, provided that NutriPacks were served to them twice to thrice a week. The percent distribution of the fortified Nutripacks+VitaMeena for the whole feeding program of region IV-A and V is 25% and 40%, respectively.

Conclusion: Nutripacks with Vita Meena effectively contributed to the improvement of the nutritional status of children by providing a balanced macronutrient and micronutrient to assure the complete nourishment of the children daily.

Keyword: Malnutrition, Food packs, Micronutrient Powder, Supplementary Food, Feeding Program

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-166

Partial replacement of red meat with legumes among healthy males for six weeks does not affect bone turnover but results in differences in amino acid intakes

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Background and objectives: A shift towards more sustainable diets is needed to mitigate climate change. More plant-based diets, however, may be harmful for bone health due to lower calcium and vitamin D content. Studies have also shown a role of specific amino acids such as arginine and lysine on bone. We studied the effects of replacing part of the red and processed meat with legume foods in a habitual Finnish diet on bone turnover and amino acid intakes.

Methods: Healthy adult men (n=102) were stratified by age and randomized into two dietary intervention groups for 6 weeks in parallel design. Group 1 received 760 g of red and processed meat per week (cooked, boneless), corresponding to 25% of protein intake, and representing the current average intake of red and processed meat in Finnish men. Group 2 received 200 g of red and processed meat per week (5% of protein intake), and pea and faba bean products (20% of protein intake). Otherwise, the volunteers followed their habitual diets. Bone turnover and mineral metabolism biomarkers were assessed (ANCOVA, baseline-adjusted). Amino acid intakes based on 4-day food records were calculated at the endpoint of the study (t-test). Results: No differences in bone formation (bone-specific alkaline phosphatase) or resorption (tartrate-resistant acid phosphatase 5b) between the groups at the endpoint were observed (p>0.05). 25-hydroxyvitamin D decreased (p≦0.043) and parathyroid hormone increased (p≦0.006) in both groups without differences between the groups (p>0.05), neither in dietary vitamin D intakes (p>0.05). Mean dietary vitamin D intakes and serum concentrations were according to recommendations (>10 µg/d, >50 nmol/l). Intake of methionine was higher in the meat group, whereas intakes of arginine, asparagine acid, glutamic acid, leucine, phenylalanine, proline, serine, and tryphophan were higher in the legume group (p<0.05). Intakes of all amino acids in both groups were adequate according to WHO recommendations.

Conclusions: Our results indicate that decreasing red and processed meat consumption in Finnish diet to the upper level suggested by the Eat Lancet Commission and replacing the meat products with legume foods does not cause a risk for bone health and provides adequate amount of amino acids.

Keyword: bone turnover, legumes, red meat, plant protein, vitamin D

PAB(T6)-167

Food environment and food systems influence on food choices and nutrition transition in Limpopo province, South Africa

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Background and objectives: The food environment interacts with the food system, as it influences a person's food procurement and consumption. The objectives were: 1. To determine the socio-demographic profile and bio-physical environment of households; 2. To assess the communities, schools and households food environments and households' food systems; 3. To determine food choices using Dietary Diversity Score (DDS); 4. To assess the food security status and food availability in households using Household Insecurity Access Scale (HFIAS) and Coping Strategies Index (CSI); 5. To assess the health risk of the participants using anthropometric indicators , biochemical indicators and clinical indicators; and 6. To determine the association among socio-demographic information, bio-physical environment, food environments, food systems, food choices and nutrition transition.

Methodology: The study design was an analytical, cross-sectional study, using quantitative techniques. A total of 429 households were randomly selected. Food environment, food system, food choices and nutritional measurements of the households were measured and assessed, using a researcher-administered questionnaire.

Results: A majority of household informants responsible for food procurement were females (80.4%). There was a significant association ($p < 0.001$) between proximity to food stores and dietary diversity of the households. Staple foods were available in almost all surveyed households (95.6%). Food prices were reported to influence household food choices. More than half of the households (59.8%) had home gardens in their yards. Almost half of the households (48.4%,) had a low DDS score (score of 4 to 7). The study revealed that 46.0% of households were food secure. Over a third (36.2%) of households' informants were obese and 32.5% were diabetic. The mean total blood cholesterol was 3.69 ± 0.74 mmol/L. A high rate of both females (89.6%) and males (91.5%) had normal haemoglobin levels. Most of the informants had normal systolic blood pressure levels (63%), with just over half who had high diastolic levels (57%).

Conclusion: The presence of food stores in the areas provided access to obesogenic and protective foods. There is a shift from consuming more of traditional foods, fruits and vegetables to more of refined carbohydrates, animal source foods and sugar sweetened beverages.

Keyword: Food Environment, Food systems, Food choices, Nutrition transition, Food security

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-168

Food system interventions and intake of fruits and vegetables in urban Vietnam and Nigeria.

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Background and objectives: Increasing the intake of fruits and vegetables (FV) may be critical to reduce the burden of non-communicable diseases and micronutrient deficiencies in many low- and middle-income countries. We implemented a non-randomised study of food system interventions to increase affordability, acceptability and accessibility of FV. This study evaluates the effect of a combination of these three interventions in urban and peri-urban Vietnam and Nigeria.

Method: We used Dietary Quality Questionnaire to assess FV food groups consumed by 600 Vietnamese and 610 Nigerian women from the intervention neighbourhoods. Data on the number of FV groups consumed was collected before, during and after the interventions, for a total of 6 times, per country. A FV score was calculated (0-6) and information about the exposure to interventions were collected to classify respondents in the number of exposure classes (0-3). FV score was analysed over time and compared between exposure groups using (mixed) count regression models. The trend of individual FV groups was analysed with mixed logistic regression. Analysis was performed separately for each country.

Results: Both Vietnam and Nigeria, the FV score was relatively stable over time, with no increase observed from before to after the intervention period. In Vietnam, differences were found between peri-urban and urban areas with a decrease in the total score in peri-urban and an increase in urban area. Differences in the probability of consumption of individual FV groups over time were observed, especially within the fruit groups. These differences in intake over time might be linked to the seasonal availability of the products. No large difference in mean FV score was observed between the exposure groups. The degree of exposure could not explain differences in FV intake.

Conclusion: The failure of finding an effect of the interventions can be due to the low sensitivity of FV score to detected possible changes in portion sizes, the temporal changes due to Covid-19 pandemic, or the interventions not being effective on FV intake. A combination of quantitative and qualitative assessments of intakes and changes in knowledge and attitudes could provide deeper insight on the effect of the interventions.

Keyword: Fruit and vegetable, Dietary intake, Food system, Vietnam, Nigeria

Conflict of Interest Disclosure: none

Further Collaborators: none

PAB(T6)-169

Conformity of packaged food and non-alcoholic beverages labelling in supermarkets in Dakar

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Background and objectives: The World Health Organization (WHO) recommends that manufacturers improve packaged food and non-alcoholic beverage labelling to better guide consumers in their purchasing choices. Those products are required to be labelled with mandatory (food name, manufacturer, list of ingredients, nutritional value, expiry date, country of origin) and optional information (claims). In Senegal, little is known on packaged food labelling compliance with WHO guidelines, hence the aim of this study is to investigate this issue.

Methods: A market survey was conducted in the largest stores of two of the most popular retailers in Dakar between August-September 2021. Labeling data (presence and position of list of ingredients, nutritional declarations, claims and promotional strategies) were collected from food packaging.

Results: Overall, labelling data were collected of 7398 food products. All foods presented an ingredient list but only 44% had it quantified and 6% had it presented on the FOP. The nutritional value was present on 82% of products, 91% of which indicated it in the panel. Only 26% of products mentioned an GDA. Over 50% of products displayed a claim (53%) of which nearly 58% were on the FOP. Claims were more frequent in the following food categories: bakery products (82%), cereals products (81%), confectionery (78%), snacks (68%). Health-related claims were the most represented (47%), followed by environment-related ones (42%). Nutritional claims were the least mentioned (26%). Health-related claims were mostly found in spreads (84%), ready-to-eat foods (83%), condiments (80%), beverages (81%), canned fruits and vegetables (49%) while nutritional claims were more common in canned fish and sea food (68%), beverages (45%), dairy products (29%), cereals products (23%). On-pack promotions were found in 10% of products. Major promotional practices were the presence of cartoon characters (46%), characters for children (24%), and offer premium (13%). Promotions were mainly observed in confectionery (53%), bakery products (16%), cereals products (15%).

Conclusions: Food companies are getting better at providing mandatory information on packaged food, but greater efforts should be considered with regard to quantified nutritional information and use of easy labelling to recognize food products nutritional quality as already established and mandatory in many developed countries.

Keyword: Food labelling, Nutritional claims, Promotion, Supermarket, Senegal

Conflict of Interest Disclosure: The authors declare that they have no conflict of interest.

PAB(T6)-170

South East Asia Obesogenic Food Environment (SEAOFE) Study to address the Double Burden of Malnutrition through Healthier Food Retail: Preliminary Findings

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Background and objectives: The double burden of malnutrition in Southeast Asian countries is of concern. Although undernutrition rates are decreasing, overweight and obesity is rising, and micronutrient deficiencies are also prevalent. Tackling dietary intakes through multi-pronged approach focussing on retail food environment is expected to improve access to healthier foods in the community. As such, the SEAOFE Study was designed to examine the retail food environment, perspectives of consumers and retailers regarding factors influencing food retail-related decisions, and existing policies influencing food retail in four Southeast Asian countries. **Methods:** The SEAOFE study is conducted in four phases in Indonesia, Malaysia, Thailand and Philippines. Phase I involved document and database review to provide in-depth analysis of retail food landscape and health status in each country. Phase II will be conducted in two parts, namely consumer intercept survey on perception of their retail food environment, and audit of selected food retailer outlets. Phase III is a qualitative study involving in-depth interviews with food retailers to understand decision-making related to stocking of food and beverages. Phase IV involves document review and in-depth interviews with stakeholders related to retail food policy to identify opportunities for change towards healthier food retail. Throughout the study, researchers will engage closely with relevant stakeholders through regular meetings. **Results:** Phase I has been completed and findings indicate that adult malnutrition and non-communicable diseases are prevalent in all four countries, with Malaysia having the highest prevalence of overweight/obesity and diabetes, and Indonesia having the highest prevalence of hypertension. The major player in food retail industry in Indonesia, Malaysia and Philippines are local companies, whereas in Thailand it is a multi-national company. In Indonesia, traditional food retail format is more commonplace, while in the other three countries modern and traditional formats are equally frequented. With the COVID-19 pandemic, however, there is increasing evidence that online food retail and e-commerce are becoming more common. **Conclusions:** The SEAOFE study will generate evidence on consumer and retailer perspectives of the food environment. We hope to also identify opportunities and barriers towards food policy changes in order to develop evidence-informed policy recommendations in this region.

Keyword: food retail, malnutrition, obesogenic environment, policy, Southeast Asia

Conflict of Interest Disclosure: This research was funded by International Development Research Centre, Canada. The authors declare no conflict of interest.

PAB(T6)-171

Associations of plant-based foods, red meat, and dairy with gut microbiota in a population-based sample of Finnish adults

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Background and objectives: Current global food systems threaten both human health and environmental sustainability. There is an urgent need for a shift to more sustainable diets with more plant-based foods and less red meat and dairy. However, little is known on the associations of these dietary factors with gut microbiota in population-based samples. Therefore, we examined whether the consumption of plant-based foods (legumes, vegetables, fruits, cereals), red meat (red and processed meat) or dairy (fluid milk products, cheese) are related to gut microbiota diversity (alpha-diversity), compositional differences (beta-diversity), and bacterial species abundances in Finnish adults.

Methods: We used data from the National FinDiet 2002 Study (n=1329, aged 25-65 years, 55% women). Diet was assessed with 48-hour dietary recalls. Gut microbiota was analyzed using shallow shotgun sequencing. Associations of microbial features (alpha/beta-diversity and species abundances) with dietary variables were analyzed using multiple linear regression, general multivariate regression models, and permutational multivariate ANOVAs. Analyses were adjusted for relevant confounders.

Results: None of the dietary variables were associated with microbial diversity (alpha-diversity, P>0.05). Plant-based foods (R^2=0.0015, P=0.012) and dairy (R^2=0.0013, P=0.037) but not red meat (R^2=0.0008, P=0.33) explained small but significant amounts of compositional variation between individuals' microbiotas (beta-diversity). In species-level analysis, plant-based foods were associated with 35 bacterial species, including positive associations with several butyrate producers e.g., *Coprococcus eutactus* and *Eubacterium eligens* and cellulolytic species e.g., *Ruminococcus flavefaciens*. Red meat was associated with eight species, including a positive association with *Clostridium disporicum*, previously demonstrated to have a

role in secondary bile acid production and a negative association with butyrate producer *Roseburia hominis.* Dairy products were associated with 34 bacterial species, including positive associations with several known lactic producing/probiotic species such as *Streptococcus thermophilus* and *Lactobacillus delbrueckii* and opportunistic pathogens including *Enterobacter cloaca* and *Citrobacter freundii*.

Conclusions: We found that plant-based foods and dairy were associated with compositional differences in terms of beta-diversity. We also found that plant-based foods, meat, and dairy were all associated with distinctive bacterial species. Plant-based food consumption, in particular, was associated with putatively beneficial bacterial species abundances. These findings confirm and extend previous evidence mainly from small-scale studies.

Keyword: Epidemiology, Gut microbiota, Nutrition, Public health, Sustainability

Conflict of Interest Disclosure The authors declare that there is no conflict of interest related to this study.

Further Collaborators: Study group of the Legumes for sustainable food system and healthy life (Leg4Life) project.

This research has been funded by the Strategic Research Council at the Academy of Finland (grant numbers 327698 and 327699) and Academy of Finland (grant 321356).

PAB(T6)-172
Mapping the functioning and identifying the needs of the baby friendly community Initiative in Kenya using a systems approach

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Background and objectives: The Kenyan government has adopted the baby-friendly community initiative (BFCI) to promote and support optimal maternal and child nutrition (MCN) within communities primarily through community health volunteers (CHVs). The BFCI is being implemented in some communities amidst some challenges and is in the process of being scaled up nationally. We aimed to map and analyze the factors that influence the functioning of the BFCI system in Kenya and to identify the needs for its effective implementation in Kenya.

Methods: We used systems thinking tools to analyze the BFCI system which involved preliminary high-level analysis which included a strengths, weaknesses, opportunities, threats analysis; an in-depth systems mapping analysis using qualitative interviews, and identification of opportunities for further development of the BFCI. Stakeholders from government, non-governmental organizations and target communities were involved in the process. Linkages between the components of the BFCI system were mapped using influence diagrams to illustrate facilitators and barriers.

Results: Factors that influence the functioning of the Kenyan BFCI include: 1) A CHVs' level of interaction with the community which is associated with increased maternal knowledge on child feeding and access to health facilities was negatively impacted by a lack of meeting facilities, bad weather conditions and COVID-19; 2) CHV level of knowledge/competency about BFCI; and 3) funding available for BFCI activities including training and stipends for CHVs. In addition to system level factors, maternal factors were also important and included their engagement with the BFCI which enhanced their feeding practices, their opportunities for breastfeeding which were influenced by availability of breastfeeding spaces, cultural beliefs and practices, mother's time and availability; and access/referral to health facilities. Priority areas needed to enhance the BFCI system identified by stakeholders included financing, CHVs' knowledge/competency, and CHVs' level of interactions with the community.

Conclusion: The BFCI has potential to improve MCN and funding and appropriate CHV training programs are required for effective implementation. CHVs play an important role in the BFCI's implementation in Kenya and there is a need to both adequately compensate their time and improve their knowledge and competency through regular training and support supervision.

Keyword: exclusive breastfeeding, baby friendly community initiative , infant nutrition, systems mapping, maternal nutrition

Conflict of Interest Disclosure: None

PAB(T6)-173
School feeding programmes in Malmesbury, South Africa: Does the national policy match what is on the plate?

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Background and objectives: The National School Nutrition Programme (NSNP) is a nation-wide programme in South Africa that provides macro- and micronutrient-rich meals to all learners in primary and secondary schools daily. School-aged children experience an increase in motor skills, cognitive, social and emotional development. NSNP's can improve, promote and maintain healthy eating habits and assist in preventing nutritional deficiencies, excess weight gain and chronic diseases. The aim of this study was to investigate the implementation of the NSNP in primary schools in the Malmesbury area of the Western Cape, South Africa and determine the content of the served meals and whether it followed the predetermined menu guidelines; to evaluate the procurement, storage, preparation and serving conditions in the schools; and to observe whether a school food garden was established.

Methods: The study was a cross-sectional observational design. Data was collected at the selected primary schools, using an observational checklist and a self-administered questionnaire for the food handlers, NSNP coordinators and food gardener. Descriptive statistics were performed.

Results: The study area included twelve Quintile 1–3 primary schools in the Malmesbury district of the West Coast region. The findings of the study indicated that the schools implemented the NSNP well. Although the food served at the schools followed the predetermined menus, the recommended daily allowance (RDA) % for energy was not met according to the NSNP guidelines at any of the schools participating in the study. In terms of the food delivery system used, the procurement of raw materials was satisfactory and the storage conditions at the schools were clean and adequate. Preparation of meals was done by food handlers who all displayed a good sense of personal hygiene, and safe food-handling practices were observed. Food gardens at schools that had these were well maintained and the produce contributed toward the NSNP menu.

Keyword: School feeding programs, School menu, Food gardens at schools, National School Program, Nutrient intake in school children

Conclusion: The schools observed implemented the NSNP according to the guidelines, allowing the programme to reach its potential aims and have a positive impact on the learners attending school.

Conflict of Interest Disclosure No conflict of interest
Further Collaborators: None

PAB(T6)-174
Food Step – development of a sustainable health-promoting model for food services and early childhood education and care

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Background and objectives: Transformation towards more climate friendly and healthy sustainable diets requires major changes in food systems. In Finland, early childhood education and care (ECEC) centres serve three meals per day. The Food Step project aims to develop a sustainable operating model that supports children's healthy diets and reduces the climate impacts of food provision in ECEC.

Methods: The Food Step project takes place in four Finnish municipalities. The content of a sustainable food system intervention is co-created together with municipal stakeholders and food service and ECEC professionals. The participating 23 ECEC centres were cluster-randomized or quasi-cluster-randomized (8 out of 23) into intervention and control centres. The 10-month intervention covers all the children in the intervention arm's centres. The aims for the intervention menus were to increase vegetables and fruit (particularly legumes) and sustainably sourced fish, to reduce red meat, and modestly reduce milk compared to the baseline menu. The intervention also includes advanced food education and activities to reduce food waste. We assess all stakeholders' knowledge, attitudes, and practices in relation to nutrition and the climate impacts of food by questionnaires. Thus far, we have analysed the food service managers' attitudes towards the planned changes at baseline. The impact of the intervention on the diet, costs of the food system, the climate impact of the diets, and food waste in the ECEC centres will be examined.

Results: At the baseline, the food service managers (n=9) had positive attitudes towards increasing fish and reducing red meat, but were slightly critical towards reducing milk on the menu. The food services of each municipality successfully developed intervention menus that are better aligned with the current recommendations than the previous menus. The intervention started and new menus were launched in March 2022. **Conclusion:**The project promoted all stakeholders' involvement in a sustainable food system through participatory design. We will demonstrate whether a systemic food reform in food services and ECEC would lead to benefits in environmental sustainability, nutrition, and cost-effectiveness. The national model will benefit policy-makers and professionals through concrete guidelines and action initiatives necessary for the sustainable food system reform.

Keyword: food system, nutrition, food catering, climate, food waste

Conflict of Interest Disclosure: None

PAB(T6)-175
The association between the EAT-Lancet planetary health diet and abdominal obesity in the Finnish adult population

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Background and objectives: Nutrition is one of the key determinants of body weight maintenance and obesity. Furthermore, food production and consumption patterns are key factors of contributing to environmental burden. The EAT-*Lancet* Commission has recently launched the Planetary Health Diet (PHD) to consider both human health and environmental aspects. However, the association between the PHD and anthropometrics e.g., waist circumference, are examined only little so far. Therefore, our aim was to examine the association between the adherence to the EAT-*Lancet* PHD and abdominal obesity in the Finnish adult population.

Methods: We used data from the national FinHealth 2017 Study (n = 5123, aged ≧18 years, female 56%). The habitual diet

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

was assessed with a validated food frequency questionnaire. Based on the EAT-*Lancet* PHD, we developed a priori, energy-standardized (2500 kcal) dietary index score adapted for the Nordic food culture including 13 food and nutrient groups (score range 0–13 points) to evaluate diet quality. Waist circumference (WC) was measured by trained study nurses, and abdominal obesity was classified as WC ≧ 100cm for men or WC ≧ 90cm for women. Linear regression and multivariable logistic regression were used for the statistical analyses.

Results: Mean PHD score was 3,6 (SD 1,3) for men and 4,3 (SD 1,5) for women. In both men and women, 44% of participants were abdominally obese. In men, no significant association between the PHD score and WC was found (ß -0.28 with 95% CI -0.65, 0.10). In women, the PHD score was inversely associated with WC (ß -0.41 with 95% CI -0.73, -0.10). Furthermore, both men and women with higher PHD scores were less likely to have abdominal obesity although the associations were not statistically significant (men: OR 0.96 95% CI 0.90, 1.03; women: OR 0.94 95% CI 0.89, 1.00).

Conclusion: The adherence to PHD was relatively low in both Finnish men and women, however especially in women better adherence to PHD was associated with smaller WC. A diet following the EAT-*Lancet* PHD seemed to be beneficial in terms of maintaining normal WC particularly in women. However, further studies with different anthropometric measurements are warranted.

Keyword: Dietary index, Planetary health diet, Obesity, Waist circumference, Sustainability

Conflict of Interest Disclosure: The authors report no conflicts of interest.

Further Collaborators: Research related to this abstract was funded by the scholarship from Yrjö Jahnsson Foundation, Juho Vainio Foundation, and the Strategic Research Council at the Academy of Finland (grant numbers 327699 and 327698).

PAB(T6)-176
Importance of tailored technical assistance for sustaining high coverage of 2-dose vitamin A supplementation (VAS) in Nigeria: A case study of Katsina State

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Background and objectives: Nigeria uses the biannual Maternal, New-born and Child Health Weeks (MNCHW) to deliver essential health and nutrition services, including VAS for children 6-59 months of age. Between 2014-2019, Katsina state received funding from the state government and financial and technical support from partners to implement the MCNHW. During this time, 2-dose VAS coverage in the state reached over 80%. VAS coverage in Katsina dropped to 0 in 2019, as the state was only able to provide one dose of VAS. This was due to multi-dimensional challenges, including loss of funding and support from partners, inadequate state nutrition leadership and lack of a clear sustainability plan to maintain the success of the MNCHW after partners exit. The objective of this ongoing project is to provide tailored technical and financial support to the Katsina State government to improve and sustain high 2-dose VAS coverage through effective, efficient planning and implementation of the MNCHW. **Methods:** In 2019, Nutrition International (NI) conducted a landscape analysis in Katsina to identify technical and programmatic gaps in the planning and implementation of the MNCHW. In response to the gaps identified, NI engaged a state-level consultant to provide technical support and guidance to the nutrition unit of the KSPHCDA. The tailored technical assistance focused on achieving and sustaining high VAS coverage while strengthening the capacity of the state government to implement the MNCHW. This support emphasized on improving demand creation for VAS, micro planning, coordination and supportive supervision. As part of NI's sustainability plan for the state, the technical assistance also included support for the development of 5-year costed plans for timely inclusion of the MNCHW into state annual health budgets. **Results:** Following NI's support to the state beginning in September 2020, VAS coverage improved to over 80% and this is expected to be sustained through the implementation of the 5-year plan developed with technical support from NI. **Conclusion:** The provision of tailored state-level technical and financial support is key for achieving high coverage of VAS. Technical assistance should include strategies that build resiliency and system strength to foster sustainability of the MNCHW and reduce reliance on partner support.

Keyword: Vitamin A Supplementation, Nigeria, Technical Assistance, System Strengthening, Child Survival

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-177
Nutritional knowledge and health, the Group of young students in physical education in Morocco

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Background and objectives: According to WHO, adolescence is the period of human growth and development that occurs between childhood and adulthood. It represents a critical transition period in life and is characterized by a significant rate of growth and change. A bad default or excess diet can distort this process over time. The changes that Morocco has experienced in recent decades with globalization reveal several behaviors affecting even the lifestyle of individuals and

family groups, including eating habits. The increasingly early manifestation of certain profile imbalances in young people, such as obesity or overweight, shows the importance of vigilance and education of children and adolescents in relation to lifestyle habits. However, our objective through this study is to evaluate the effect of education and nutritional knowledge of school children (n: 221) on their morphological and energy profiles (the energy balance in nutritional intake and energy expenditure) during a period of 20 weeks of study, in order to identify the eating behaviors and their effect on the physical activity of these young adolescents aged "15 to 18 years" made up mainly of pupils belonging to public schools in the city of Casablanca with an average physical practice of 2 to 3 hours per week.

Materials and methods: this is a sample of 221 school children including 120 girls and 101 boys aged (16 ± 0.8 years), height (1.67 ± 0.34 m), weight (65 ± 0. 12 kg), BMI (23). A self-administered dietary questionnaire was used to assess daily caloric intake, macronutrient distribution and antioxidant vitamin intake. Daily energy expenditure was evaluated by the factorial method. We studied nutritional knowledge using a Validated NSKQ questionnaire. As far as physical performance is concerned, several field-validated tests have been implemented to assess their motor skills and abilities (shuttle test for VO2max, 100 speed test and 1500 m endurance test).

Results: The results show that corpulence according to gender for girls (n=120) grade I undernutrition (n=9), grade II undernutrition (n=1), grade III undernutrition (n=1), normal (n=88), moderate Grade I obesity (n=3), overweight (n=18), And for boys (n=101): Grade I undernutrition (n=15), Grade II undernutrition (n =1), grade III malnutrition (n=2), normal (n=76), moderate Grade I obesity (n=2), overweight (n=5). Students who were of normal build achieved higher scores than those who were not ($p < 0.05$). The daily caloric intake is (2134.7 ± 1.4 kcal d^{-1}) and the macronutrient distribution (Carbohydrates: 53%, Proteins: 13%, Fats: 34%) while the energy expenditure is (3034, 5 ± 1.7 kcal.d^{-1}), with a deficit of 899.8 ± 1.3 kcal.d^{-1} is within the norms for moderate athletes, The analyses demonstrated significant associations between the level of performance and the energy intake ($P < 0.04$).

Conclusions: The students studied have an unbalanced diet in macronutrients with a high level of lipids. Similarly, these students suffer from a strong deficit in antioxidant vitamins A, E and D. Students nutrient intake should be monitored by their family or a nutrition professional. Each subject must have an individual diet. Nutrition education must be organized and the families of these students must be included in these training sessions.

Keyword: Nutrition, Nutrition knowledge, Eating habits, Teens, obesity

PAB(T6)-178
Importance of well-trained health staff during pregnancy in semi-urban and rural surrounding of Bukavu, DR Congo

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Background and objectives: Birth weight (BW) is influenced by maternal factors and health and nutrition during pregnancy as well as use of well-trained health services can play an important role. Within the scope of a nutrition study, it was aimed to compare health care during pregnancy and birth outcomes between semi-urban and rural areas around Bukavu, DR Congo.

Methods: At baseline of a cross-sectional follow-up study, 471 mother-infant pairs were recruited during the first week postpartum in two semi-urban and one rural hospital. BW was recorded by postpartum mothers and a structured questionnaire including retrospective information about health and nutrition during pregnancy as well as practicing family planning was applied. Descriptive statistics, chi-square-tests, Student's t-test, Mann-Whitney U-test, and multiple linear regression analysis were used. Practices related to health services are presented.

Results: BW was significantly lower in rural than in semi-urban areas (3004±468 g vs. 3263±444 g) along with a higher prevalence of low birth weight (10.7% vs. 2.7%). Maternal mid-upper arm circumference (MUAC) also differed significantly between rural and semi-urban mothers (23.8±2.1 cm vs. 26.9±3.1 cm). Compared to the semi-urban mothers, less rural women reported to have practiced family planning (3.1% vs. 17.1%), taken any medication during pregnancy (85.4% vs. 92.2%) which was most prominent for the use of deworming (24.6% vs. 88.3%) and antimalarial drugs (80.8% vs. 88.6%), taken nutritional supplements (81.5% vs. 89.3%), and have received information about nutrition by medical staff, a friend, or the mother (32.8%, 0.8%, 0.0% vs. 46.5%, 8.5%, 8.5%, respectively). Having experienced health problems during pregnancy and use of mosquito nets did not differ significantly between the study areas. In the rural hospital, breastfeeding was initiated less frequently within the first hour after birth (87.8% vs. 93.8%) as recommended by WHO/UNICEF.
Lower maternal MUAC, age, gestational age, primipara, female sex, and rural location were significantly associated with lower BW.

Conclusions: Poorer birth outcomes in rural areas might be partly mediated by maternal undernutrition and lower use of health services. Antenatal and perinatal care need to be strengthened especially in rural health facilities to benefit both maternal and newborns' nutrition and health status.

Keyword: Birth weight, Health services, Pregnancy

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-179

The estimated dietary and health impact of implementing the proposed 'high in' front-of-pack labelling in Canada: a macrosimulation modeling study

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Background and objectives: Front-of-pack labelling (FOPL) has been identified as a cost-effective policy to promote healthier diets. In 2016, Chile was the first country to implement a mandatory 'high in' warning label (WL). Chilean consumer surveys report that between 30% and 60% of consumers choose products with less WL. Health Canada has similarly proposed a FOPL system mandating that packaged foods exceeding predetermined thresholds for sodium, total sugars, and/or saturated fat are required to display a 'high in' WL. The aims were to estimate the potential 1) dietary impact of substituting foods with similar foods that would carry at least one less WL, and 2) the number of diet-related noncommunicable disease (NCD) deaths that could be averted or delayed due to estimated dietary changes.

Methods: Baseline and counterfactual intakes of sodium, total sugars, saturated fats, and calories were estimated among Canadian adults (n=11,992) using both available days of 24h recall data from the 2015 Canadian Community Health Survey-Nutrition (CCHS). Using a Canadian branded food composition database, we identified similar foods to those reported in CCHS that would carry at least one less WL (n=272). Based on the Chilean experience, we substituted identified foods for 30% and 60 % (randomly selected) of CCHS respondents. Potential health impacts were estimated using the Preventable Risk Integrated ModEl (PRIME) macrosimulation model.

Results: Mean dietary reductions of 108 mg and 216 mg/d of sodium, 3.0 g and 5.7 g/d of sugars, 0.2 g and 0.3 g/d of saturated fats, and 16 kcal and 33 kcal/d of calories were estimated due to food substitution for 30% and 60% of CCHS respondents, respectively. Between 2,701 (95% CI 2,397-3,013) and 5,189 (95% CI 4,595-5,771) deaths due to diet-related NCDs, primarily from cardiovascular diseases (71%), could potentially be averted or delayed in a year by implementing FOPL in Canada.

Conclusions: Results suggest that FOPL could significantly reduce sodium and total sugar intakes among Canadian adults, the consequences of which could prevent or delay an important number of diet-related NCD deaths. These findings can inform policy decisions related to final approval and implementation of FOPL in Canada.

Keyword: Front-of-pack nutrition label, dietary intakes, non-communicable diseases, macrosimulation model, NCD scenario modelling

PAB(T6)-180

Niger's Climate Crises: Role of Food Security Responses and Nutrition Investments in Maternal and Neonatal Mortality Reduction

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Background and objectives: Niger has been plagued by high rates of poverty, environmental crises, food insecurity, and political instability, and ranks amongst the highest in the world in climate-vulnerability. Yet, it surpassed West African counterparts in greatly reducing newborn and maternal mortality over the past two decades. The study objective was to understand the climate-related food insecurity evolution in Niger and how the country's nutrition policy and programmatic focus in the most affected regions may have improved health and nutrition of mothers and newborns.

Methods: We used national household surveys from 1998, 2006, 2009 and 2012 to explore descriptive trends in maternal and newborn nutritional indicators (women's weight, anemia during pregnancy, and iron folate supplementation coverage, breastfeeding practices, child stunting and wasting). Through a desk review and in-depth key informant interviews we reviewed national and subnational nutrition policies and programs. **Results:** There were two severe food crises in 2005 and 2010 primarily impacting four regions in Niger. From 2010 to present, maternal, newborn, and child nutrition, food security, and resilience programs in Niger were increasingly implemented nationally or in the four most vulnerable regions. Each prioritized region saw major improvements in key indicators, above what was seen in other subregions. From 1998 to 2012, there were large improvements in anemia during pregnancy, improvements in iron supplementation coverage, early initiation of breastfeeding, and the birth disadvantage for wasting disappeared completely in several of the vulnerable regions. **Conclusions**: Results suggest that health and nutrition interventions in targeted regions played a large role in improving food security, maternal, fetal growth, and neonatal health. Policy and program efforts helped to offset any substantial rise in nutrition-related maternal and newborn mortality caused by repeated food crises in the hardest hit regions. Major drivers of food insecurity and malnutrition such as conflict, climate variability and extremes are expected to increase in the coming years and countries will need to prepare for future shocks. Similar methods can be replicated in other countries facing climate crises to understand the relationships between targeted nutrition and food security actions and reductions in maternal and neonatal mortality.

Keyword: Climate, Food Security , Maternal and Neonatal Nutrition , Growth Faltering, Environment

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-181

Assessment of Nutritional Status of Underweight Children aged 3 to 5 years old using Nutribun paired with Lipid-Based Nutrient Supplement (LNS) in Region IV-A

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Background and objective: In 2018, 19.1% of Filipino children below 5 years old are underweight according to the World Bank Group. The Department of Social Welfare and Development (DSWD) implemented the Supplementary Feeding Programs (SFP) to diminish the growth of these numbers. A reformulated Nutribun paired with Enov' Nutributter Lipid-Based Nutrient Supplement (LNS) was given through this program. The reformulated nutribun comes in a smaller serving size - 80g vs. 160 g of the original formulation. It also uses skimmed milk and bread flour as the main sources of protein instead of soy fortified flour. It comes with LNS that can be used as a spread. When combined both will provide around 325 kcal and 10 g of protein. The main objective of this study is to assess the effect of nutribun paired with LNS in the nutritional status of underweight children in Region IV-A.

Methods: The study involved 12,985 underweight and severely underweight children as part of the feeding program in Region IV-A. The children were fed twice a day for 120 days with supplementary food, wherein Nutribuns with lipid-based nutrient supplement is served every two weeks and consumed in alternate days, along with other food items provided in the program. The improvement in the nutritional status of children was assessed by comparing their weight for age, based on the Child Growth Standards provided by the World Health Organization, prior to and after the feeding activity.

Results: 61.45 % of the total number of children had improvement in their nutritional status, provided that Nutribuns were consumed three to four times a week. The percent distribution of nutribun in the feeding program covers about 35% of the total program.

Conclusion: Nutribuns paired with LNS contributed effectively to the improvement of the nutritional Status of underweight children in Region IV-A. Nutribun with lipid-based nutrient supplement is an ideal option in feeding programs as it is both caloric and nutrient dense, enough to supplement for the daily requirement of the children.

Keyword: Underweight, Nutribun, Lipid-Based Nutrient Supplement, Supplementary Food, Nutrient Dense

PAB(T6)-182

Changes in the availability of ultra-processed foods offered in state-run public schools' meals in Brazil: evidence from a locally led intervention

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Background and objectives: School Feeding Programs (SFP) across the globe have been associated with better dietary and educational outcomes. Delivering a program that promote healthy eating while protecting students from the exposure to unhealthy foods, such as ultra-processed foods (UPF), can, however, be challenging. We explored whether a locally led intervention to optimize the implementation of the Brazilian National SFP "*Cozinheiros da Educacao*" was associated with changes in the proportion of UPF offered in state-run schools.

Methods: Longitudinal study that used publicly available data on 4,410 unique state-run school lunch and snack menus from from 645 municipalities between 2015 and 2019. We employed a two-way fixed effects model to assess yearly changes in the proportion of UPF (%) in school menus controlled for school- and municipality-level covariates and day of the week. We ran similar models to explore whether the *Cozinheiros da Educacao* program menus were associated with less UPF items for each school/year. This program had a staggered implementation from 2016 to 2019, when it was ended, and combined changes in the supply chain that allowed schools to receive unprocessed meats, inclusion of traditional local dishes and training provided to school cooks by a known local chef. Models were controlled for concomitant federal transfers to improve school lunch menus. Finally, we ran sensitivity analysis for state-run schools from the Sao Paulo Metropolitan Area, where the program had a wider reach.

Results: The overall proportion of UPF items in lunch menus decreased by 13.6 percentage points (p.p.) ($p<0.001$) between 2016 and 2018, with a slight increase in 2019. Similar trends were observed for breakfast and snack menus. *Cozinheiros da Educacao* Program was statistically associated with reductions in the proportion of UPF in lunch (-2.76; SE=0.94) and snack menus (-2.8 and 6.73; SE-2.01). Analyses restricted to the Sao Paulo Metropolitan Area provided similar results. **Conclusion**: We found that this locally led intervention aimed to replace UPF for unprocessed foods was associated with reductions in the proportion of UPF in school menus. Our findings can help inform further impact evaluation analyses and provide evidence to improve the quality of public schools' menus.

Keyword: School Food environment, School Feeding Programs, Food Policy, Ultra-processed foods, Evaluation

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-183
Resilience in the delivery of Vitamin A supplementation (VAS) during the COVID-19 pandemic: A case study in Kenya

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Background and objectives: Kenya's VAS policy specified routine health facility contacts, outreach and integration into campaigns to reach children 6-59 months with VAS. In 2017, the policy was revised to include distribution through community units (CUs) and Early Childhood Development centres (ECDs). Following this revision, Nutrition International (NI) conducted a demonstration project in Muranga county to systematically explore mechanisms to optimize VAS delivery through this expanded list of approaches. Using learnings from the demonstration project, NI further supported select county governments to optimize VAS delivery. This initiative demonstrated the immense potential of the CUs to improve VAS coverage. The COVID-19 pandemic caused severe disruptions to service delivery in Kenya, as well as increased hesitancy of community members to attend health facilities for fear of infection. As a result, VAS coverage was projected to drop by 30% in 2020. To minimize this, NI used lessons learned from the optimization project to support national and county governments to maximize coverage in the context of COVID-19.

Methods: The national VAS taskforce responded quickly to reduce the impact of the pandemic on the VAS program by developing operational guidelines for VAS during the pandemic, strengthening coordination mechanisms at national and sub-national levels, engaging and coordinating partners, building the capacity of CHVs to deliver VAS and adjusting budgets to accommodate task-shifting in service delivery. Lessons learned and VAS planning tools from NI's demonstration project were incorporated in the operational guide and disseminated to support VAS programming across the country.

Results: Two-dose VAS coverage in Kenya increased from 67% in 2019 (pre-covid) to 82% and 86% in 2020 and 2021, respectively, despite significant disruptions to the health system caused by the pandemic. This success was largely because VAS continued to be delivered in the community via the CHVs. In addition, NI's VAS microplanning tool was used across the country to facilitate efficient planning and resource allocation to reach all eligible children.

Conclusions: Diversifying VAS delivery approaches is critical for sustained coverage during disruptions to health systems, ensuring continuity when one platform is affected. Microplanning for VAS is an important tool, for sustained planning and delivery of VAS. Lastly, a robust community health strategy provides a resilient delivery platform for essential health and nutrition services as it did in Kenya during the COVID-19 pandemic.

Keyword: Vitamin A Supplementation, VAS coverage, CHV, Optimization, COVID-19

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-184
Choline, docosahexaenoic acid, and diarrheal disease associated with growth faltering in a case control study

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Background and Objectives: Children with malnutrition are more susceptible to recurrent infectious diarrhea episodes and subsequent morphologic and functional enteric changes which may further compound growth faltering. DHA and choline status may influence these relationships given the role these biomarkers play in lipid metabolism, gut immunity, and inflammatory mediation. Here we aimed to examine the potential contributions of DHA, choline, and enteric damage in young children with diarrheal illness and the associated child growth outcomes.

Methods: We developed a longitudinal case-control study in children 6-36 months of age (N=195) living in Cap-Haitien, Haiti. Mother-child dyads were recruited from community health posts and cases were defined as having three or more liquid stools in the last three days. Child anthropometry, dietary intake, blood, and stool samples were collected at baseline and at the one-month follow-up. Plasma DHA, choline and betaine were measured using liquid chromatography tandem mass spectrometry methods (n=49). Intestinal fatty acid binding protein (I-FABP) completed by enzyme-linked immunoassay (n=183). Multivariate regression models were used, along with mediation analyses to examine these associations and adjust for confounding factors.

Results: Mean plasma DHA and choline concentrations were low in both cases and controls at baseline and follow-up visit. Mean plasma I-FABP levels were high in both groups, but significantly higher at one-month follow-up in cases compared to controls (3.20, 95% CI: 3.13, 3.27 and 3.34, 95% CI: 3.28, 3.40, respectively, p = 0.002). In multivariate regression models, higher plasma choline at one-month follow-up was protective (AOR 0.1, 95% CI: 0.011, 0.904, p= 0.04) against being underweight at follow-up. Higher plasma DHA at follow-up was associated with decreases in weight-age-z-score (p=0.016). Follow-up I-FABP was inversely correlated height-age-z-score (p=0.033). Mediation analyses were found to be non-significant.

Conclusions*:* This study found the children had low levels of plasma DHA and choline and high I-FABP concentrations which suggest high prevalence of malnutrition and enteric damage. Trends found in plasma choline and DHA indicate they may have a role in growth outcomes in this context.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: betaine, stunting, intestinal fatty acid binding protein, mass spectrometry, underweight

Conflict of Interest Disclosure: There are no financial conflicts of interest by any of the research team members.

PAB(T6)-185
A longitudinal assessment of rural food environments in Sri Lanka during Covid-19

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Background and objectives: Food environments are a critical determinant of diet quality, yet remain understudied in low-and-middle-income countries, especially in remote, rural communities. Sri Lanka has experienced a growing foreign exchange crisis during the Covid-19 pandemic, which has contributed to food price inflation and reports of food shortages. This study aims to assess how rural food environments, specifically the availability and cost of a healthy diet, have been affected.

Methods: Market surveys were conducted in open-air markets (n=16) and village retail shops (n=122) across 45 Grama Niladhari (GN) Divisions at 10 time points, from December 2020 to December 2021. Food availability was assessed according to the feasibility of sourcing sufficient variety of foods to meet national food-based dietary guidelines (FBDG). Cost was assessed as the minimum cost of adhering to FBDG (CORD). Secondary data was attained from Sri Lanka's national food price surveillance system to compare the trend in CORD in the study area, composed of rural communities, to the national average, which primarily reflects urban centers. CORD estimates were deflated by non-food price inflation. A generalized least squares model was used to test for difference in trajectories.

Results: In December 2020, 84% of the study GNs had sufficiently diverse foods for FBDG. However, by September 2021 only 62% had sufficiently diverse foods; supply of dairy products and fruit were particularly constrained. CORD was estimated at $2.63 (constant Dec.'20 LKR 155) per person per day in December 2020 and $3.32 (constant Dec.'20 LKR 196) in December 2021, an average GN-level increase of 25%. At its highest, nominal CORD represented 115% of household food expenditure. CORD increased at a significantly faster rate in the study area compared to the national average; though it was 20% lower in December 2020, by December 2021 the two were approximately equal.

Conclusions: Covid-19 and the macroeconomic pressures faced by Sri Lanka have seen an erosion in the availability and affordability of a healthy diet in the study area. The cost of a healthy diet may have increased more in rural parts of Sri Lanka, where market connectivity is relatively lower and food insecurity already high.

Keyword: Food environment, Sri Lanka, food affordability, rural, Covid-19

PAB(T6)-186
Is there an association between poor mental health and the nutritional status of Syrian refugee mothers and their children under five? A cross-sectional study in Greater Beirut, Lebanon

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Background and objectives: More than one out of four mothers were found to suffer from a form of depression and/or post-traumatic stress disorder (PTSD) among Syrian refugees in Greater Beirut, Lebanon. The objective is to examine the associations of socio-economic characteristics, nutritional inadequacies, nutritional status, and anemia of mothers and their children aged under five years with maternal mental health status.

Methods: A cross-sectional study was conducted among Syrian refugee mothers of children under five years from June-October 2018 in Greater Beirut, Lebanon (n=433). Data was gathered on socio-economic, maternal health, dietary intake (24-hour recalls), and anthropometric characteristics. Hemoglobin concentrations were measured using the HemoCue Hb301+ analyzer. Mental health was assessed using the Patient Health Questionnaire-9 (PHQ-9) for depression and the Mini International Neuropsychiatric Interview (MINI) for PTSD. Descriptive statistics, chi-square test and ANOVA were applied.

Results: Out of 432 mothers included in this study, 13.9% were found to suffer from moderate or severe depression, 6.9% from PTSD, and 6.2% from the co-occurrence of depression and PTSD. Being older in age, having a baby girl, a higher number of children under five in the household, a higher crowding index, lower use of micronutrient supplements, suffering from a flu or chronic disease, experiencing symptoms including headaches, dizziness, difficulty concentrating, undergoing a Caesarean section, and not having breakfast daily were found to be significantly associated with poor mental health among mothers. No associations were found between poor mental health and anemia, nutritional status, and nutritional inadequacy among mothers and anemia among children, except for maternal selenium intake. Proportions of nutritional inadequacy for selenium among mothers and of overweight/obesity (BMI-for age > +2) among children were significantly higher when mothers were suffering from PTSD or depression.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusion: Poor mental health is associated with various socio-economic and health characteristics among Syrian refugee mothers in Greater Beirut, Lebanon. It might play a crucial role in caregiving and impact the nutrition of offspring's, indicating the need to improve nutrition and mental health services for refugees. In-depth analysis is required to examine the determinants of poor mental health and its associations with maternal dietary patterns among refugees.

Keyword: Mental Health, Women of Reproductive Age, Refugees, Nutrition, Diet

Conflict of Interest Disclosure None

Further Collaborators: None

PAB(T6)-187
Food Models for Treatment of Children with Moderate and Severe Acute Malnutrition: A Narrative Review

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i. Background & Objectives: The community-based management of acute malnutrition (CMAM) involves the provision of ready-to-use therapeutic foods (RUTF) or other nutrient-dense foods for the treatment for malnourished children without medical complications. Standard milk -peanut based RUTFs are expensive which impact the implementation of such programs on large scale. Instead, food-based alternatives to the standard RUTF formulations are practised by local community in CMAM programs. Thus, this study has attempted for a comprehensive review of the evidences on efficacy and appropriateness of such food-based strategies.

ii. Methods: The review compared different food models used in the treatment of severe and moderately acute (SAM, MAM) malnourished children of<5y. A computerised keyword search was conducted on databases such as PubMed, Cochrane and REFINE. A snowball method was also used to identify literature across set inclusion and exclusion criteria. The first part of analysis compared nutrition outcomes of different approaches to assess efficacy in addition to strength and limitations. The second part of the review focused on nutrition composition of the different food approaches.

iii. Results: The results for efficacy were mixed. Individual trials reported better recovery rates with standard RUTF compared to alternative RUTFs for SAM children however few also showcased that alternative formulations were not inferior. Some evidences showed better impact of certain alternative formulations to treat anaemia, very common among SAM children. The food analysis indicated two major concerns with the standard milk-peanut formulations i.e imbalance of omega 6:omega 3 ratio and high amount of added sugar. RUSF and LNS showed better outcomes for MAM children.

iv. Conclusion: Nutrient dense food-based models alternative to RUTF were observed to be a sustainable approach to manage malnourished children at community level.

Keyword: Community-Based Management of Acute Malnutrition, Ready-to-use Therapeutic Food, Severe Acute Malnutrition, Moderate Acute Malnutrition

Conflict of Interest Disclosure: No.

PAB(T6)-188
BMI–for-age z-score between girls and boys of Mapuche ethnicity and descendants of Europeans living in rural and urban areas: A systematic review and meta-analysis

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Background and objectives: A study reported significantly higher BMI-for-age z-score (BMIa-zs) in children of Mapuche ethnicity compared to those of European descent (Bustos 2009). This systematic review and meta-analysis aimed to compare the BMIa-zs between girls and boys of both groups living in urban and rural areas.

Methods: This systematic review and meta-analysis was recorded in Prospero (CRD42017069924), and the protocol can be consulted elsewhere (Fernandez-Cao 2018). The search was performed in PubMed/Medline, Scopus, Web of Science and SciELO until October 2020. Observational studies conducted on girls or boys of Mapuche ethnicity and descendants of Europeans living in urban or rural areas, separately; providing data on BMIa-zs; and published in English, Spanish were included. The selection process was performed first, from title and abstract, and then through the full text of relevant manuscripts. The global mean difference (GMD) and the 95% confidence interval (CI) were estimated using the generic inverse variance method applying random-effects models. Stratified analysis was conducted to examine the effect of sex on results. Heterogeneity was assessed by the Cochran Q-statistic and the I2 statistic, and the publication bias through the Egger's and Begg's tests. All analyses were performed with STATA 15.

Results: From 3,141 records initially identified, two were selected (Amigo 2010) (Fernandez 2019). No studies performed in rural areas were found. Stratified analysis based on the sex showed non-significant differences for BMIa-zs between girls of Mapuche ethnicity and descendants of Europeans living in urban areas (GMD= 0.10; 95% CI: -0.23, 0.42), and neither among children of both ethnic groups (GMD= 0.54; 95% CI: -0.16, 1.24). Consequently, the GMD for the BMIa-zs of children living in urban areas was 0.16 (95% CI: -0.13, 0.45), with a moderate heterogeneity (I2 = 38.3%). No evidence of publication bias was found.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: A limited number of studies with relevant information were found. No differences in the BMIa-zs between girls or boys of Mapuche ethnicity living in urban areas compared to European descent were observed. Further studies are needed to investigate possible differences in the BMIa-zs of children of both ethnic groups according to sex and the area of residence.

Keyword: BMI, children, urbanization, Mapuche, systematic review

Conflict of Interest Disclosure: J. Fernández-Cao Grant / Research Support from: DIUDA Regular 22385, C. Doepking Grant / Research Support from: DIUDA Regular 22385.

PAB(T6)-189
Iron-folate supplementation coverage among pregnant women in federal capital territory, Abuja Nigeria

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Background and objectives: Pregnant women in the Federal Capital Territory (FCT) Abuja, Nigeria receive iron and folic acid supplements routinely in the health facilities during antenatal as well as during the biannual maternal newborn and child health week (MNCHW). This study determined iron-folate supplementation coverage in FCT, the knowledge of the women on the benefits of the supplements, and the site they received the supplements.

Methods: A cross-sectional survey design was adopted in the study. Cluster random sampling technique was used to sample 849 respondents from 30 households in 30 communities in the six Area Councils of FCT. The questionnaire was used to elicit information from the respondents. The data were analyzed using descriptive statistics.

Results: Iron-folate coverage was 91.4% among the respondents, while 6.6% were not covered. The site majority (56%) of them received their supplements was at Primary Health Centre (PHC), 27% received it at Secondary and/or Tertiary Health Care Facilities and others received it at home (0.4%) and temporary health post (1.4%). Also, 251 respondents out of 849 did not know the benefits of iron-folate supplementations, only 73 (8.6%) knew that it could prevent birth defects and just 5.8% (49) knew that it could reduce mortality.

Conclusion: here is high coverage of iron-folate supplements among women in FCT, PHCs are the major supplementation site, but the knowledge on the various benefits of these supplements is low. Therefore, nutrition education among women should be increased on the benefits of iron-folate supplements to the pregnant woman and her foetus to stimulate self-motivation in the intake.

Keyword: Iron-folate, Supplementation, Pregnant women

Conflict of Interest Disclosure There is no conflict of interest to declare

PAB(T6)-190
Valuation of wild edible plants in 3 regions in Morocco at different distances from the Mediterranean: Ethnobotanical Study.

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Our ethnobotanical study revealed the central importance of wild edible plants in several types of uses by the rural populations of the Casablanca-Settat region of Morocco. The study also reported that in this region, the elderly are the bearers of this cultural heritage, which must now be transferred to the younger generation to avoid the danger of their disappearance. In this framework, comes this present work; which is a logical continuation of our previous works. With a very particular accent on the characterization of traditional use of these plants with integration this time of a group of sellers of these last ones to give an outline on their modes of marketing within an informal sector threatened of disappearance.

The objective of this work was to inventory the uses and marketing of spontaneous edible plants among the survey population. In order to know the edible organ, its mode of consumption (recipe), the frequency, the type of use, its state of commercialization, their availability at the market, the plant organ sold, its average price, number and frequency of sellers for each species. An ethnobotanical survey consisted of interviews with consumers and traders of these plants using a pre-established questionnaire. The study reports a total of 78 plant species belonging to 36 families were identified, only plant species representing a use description or recipe were considered. 48 recipes were cited, of which 24 were for food use, 11 for medicinal use, 14 for food and medicinal use, and 2 for food and other use. Only one recipe for each of the following uses: food/medicinal/cosmetic, food/medicinal and other. Finally, 25 recipes for other uses in the locations studied. The most consumed plant parts were leaves (21.53%), followed by all the aerial part (18.46%), stems (16.92%), tubers or roots (15.38%), seeds (9.23%) , fruits (7.69%), flowers (4.61%), rhizomes (3.07%), fillets, stamens and receptacles (1.53%)

The results of this research contribute to document the modes of use of the identified wild edible plants which deserve to be valued in order to fight against their disappearance by their domestication.

Keyword: Wild edible plants, ethnobotanical survey, mode of use, mode of marketing

Conflict of Interest Disclosure: Any conflict

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-191

Reporting of dietary patterns and implications for evidence synthesis and translation

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Background and objectives: Dietary patterns evidence can be difficult to synthesise and translate into dietary guidelines when a quantitative description of the foods and nutrients contained with each dietary pattern is not provided, and when the dietary patterns are named using different criteria. The aims of this systematic review were to analyse the application and reporting of dietary pattern assessment methods, and the reporting of the dietary patterns that were analysed with health outcomes.

Methods: Three electronic databases were searched (Medline, Embase, and Global Health). Cohort and nested case control studies with dietary pattern exposures and health outcomes, published between 1980 and 2019 were eligible for inclusion. A narrative synthesis was conducted and descriptive statistics were used to summarise the data.

Results: This systematic review included 410 studies. Some studies used multiple dietary pattern assessment methods. In studies that used index-based methods (n=257), 463 distinct indices were used. Food and nutrient profiles were provided for 30.0% and 49.2% of indices respectively. Compared to Mediterranean diet indices and adaptations of the Healthy Eating Index, food and nutrient profiles were reported more frequently for Dietary Approaches to Stop Hypertension (DASH) indices. In studies that used factor analysis or principal component analysis (FA/PCA) (n=125) or cluster analysis (CA) (n=23), dietary patterns were frequently named using qualitative labels (e.g. healthy, western, Mediterranean, traditional) or based on the names of the foods that characterised the dietary pattern (e.g. vegetables pattern, meat pattern). In studies that used reduced rank regression (RRR) (n=26), basic labels were most commonly used (e.g. pattern 1, 2, 3), followed by the names of the intermediate variables (e.g. estrogen food pattern, c-peptide dietary pattern). Food profiles were reported for all the dietary patterns that were analysed with health outcomes in only 31.2% of FA/PCA studies, 46.2% of RRR studies, and 43.5% of CA studies. Nutrient profiles were reported for all dietary patterns in 50.4% of FA/PCA studies, 57.7% of RRR studies, and 47.8% of CA studies.

Conclusions: To ensure dietary patterns evidence can be synthesised and translated into dietary guidelines, standardised method-specific approaches for reporting dietary patterns may be needed.

Keyword: Dietary patterns, Dietary guidelines, Systematic review, Evidence synthesis, Evidence translation

PAB(T6)-192

A nutrition classification scheme combining level of processing and nutrient profiling predicts increased intake of critical nutrients and obesity prevalence in Australia

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Background and objectives: Nutrition policy actions such as food taxes, restrictions on marketing, and interpretive front-of-pack labelling (FOPL), are recommended to modify the food environment and promote healthy dietary behaviours. Nutrient-based nutrition classification schemes (NCSs) are often used to inform policy actions but do not account for level of processing. A prototype for a novel approach to NCS combining level of processing and nutrient profiling has been developed. The aim of this study was to examine the association between consumption of foods classified as 'unhealthy' by the prototype NCS and the intake of nutrients linked to non-communicable disease, and obesity in the Australian population.

Methods: A cross-sectional analysis of dietary and anthropometric data of 9,114 Australians aged >=19 from the National Nutrition and Physical Activity Survey 2011-2012 was conducted. Food and beverage items were classified by the prototype NCS. This involved classification by NOVA, and application of upper thresholds for sodium and free sugars, resulting in a binary output of 'healthy' (Group 1, group 2, and group 3 under nutrient thresholds) or 'unhealthy' (Group 4, and group 3 exceeding nutrient thresholds). The contribution of unhealthy foods to total energy intake and the mean sodium and free sugar intake over quintiles of unhealthy food consumption was examined. Adjusted linear and logistic regression models were used to analyse the association of the dietary share of unhealthy foods and obesity indicators (body mass index as continuous and categorised as >=30kg/m^2).

Results: Unhealthy foods (as classified by the prototype) contributed on average 49.7% of energy intake. A positive and statistically significant trend was observed between increasing quintiles of unhealthy food consumption and intake of free sugars (coef 2.37, p<0.001) and sodium (coef 0.13, p<0.001). In the multivariable regression analysis, those in the highest quintile of unhealthy foods consumption had significantly higher BMI (0.71 kg/m2; 95%CI 0.21, 1.21), and higher odds of having obesity (OR=1.53; 95%CI 1.22, 1.91) compared with those in the lowest quintile of consumption.

Conclusions: A NCS combining level of processing and nutrient thresholds predicts intake of free sugars and sodium, and prevalence of obesity in the Australian population.

Keyword: Nutrition Classification, Policy Actions, Ultra-processed Foods, Nutrient Profiling, Obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-193

CRESCER project- a cluster randomized controlled trial of the effectiveness of nutrition-sensitive and nutrition-specific interventions to prevent stunting in children under two in southern Angola: study design and baseline characteristics

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Background and objectives: According to UNICEF, 7.3 million people in Angola face food and nutrition insecurity. Recurrent drought, reduced agricultural production, crop failures and the proliferation of infectious diseases are particularly compromising maternal and infant nutrition and health. Southern provinces are the most affected with high children malnutrition rates. Stunting prevalence reached 49.9% and 37.2% respectively in the provinces of Huila and Cunene. Implementing multi-sectoral interventions on the first 1000 days of life is key to prevent chronic malnutrition but evidence on the effectiveness of different options is limited. The CRESCER project aims to evaluate the impact and effectiveness of three interventions on stunting by implementing a community-based randomized controlled trial (c-RCT) in southern Angola.

Methods: This three-arm cluster randomized controlled trial of non-inferiority is set among FRESAN program communities in Huila and Cunene. We defined a control arm common to all arms as the standard of care (SOC) including health promotion activities, malaria prophylaxis, deworming and vitamin A supplementation. Pregnant women and their newborn children are target recipients of either arm: SOC, SOC+ nutrition supplementation with "Small-quantity lipid-based nutrient supplementation" (SQ-LNS) and family food ration, or SOC + unconditional cash transfers. Community and Health Development Agents (ADECOS) implement the interventions following Angolan government protocols. A total of 52 clusters will be randomized (13 clusters/arm). A minimum of 40 pregnant women per cluster are estimated. The primary outcomes are prevalence of stunting and mortality in children.

Results: Data collection and interventions implementation began in March 2022 and will end in October 2024. A total of 1440 pregnant women and their newborns, 480 in each arm, are enrolled to detect a 13% reduction in the prevalence of stunting among children aged 24 months. Primary efficacy analyses will be performed when participant's children have completed a total of 24 months of follow-up.

Conclusions: The findings of this trial will provide robust evidence on which intervention package can have the greatest impact on preventing stunting in children under two in Angola and improve comparability with other contexts.

Keyword: Angola, Stunting, Nutritional supplementatio, Cash transfers, Multi sectoral nutrition programme

Further Collaborators: Israel Molina, José Carlos Lima, Amador Gómez, Antonio Vargas, Clélia Manuel, Maria Luisa Aznar, Esperanza Esteban

PAB(T6)-194

Coverage of micronutrients needs of women and young children by diet and micronutrient interventions: cases study of Ghana and Benin

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Background and Objectives: In West Africa, widespread micronutrient deficiencies impact negatively the nutrition and health of the most vulnerable populations. To better understand pathways to improve micronutrient status, we estimated the contribution of diets, micronutrients interventions and specific foods to micronutrients needs of women of reproductive age (WRA) and young children in Ghana and Benin.

Methods: In both countries, scenarios of usual diets for WRA (15-49 yrs, non-pregnant and pregnant/lactating women), and breastfeeding and complementary diets for children (6-8, 9-12 and 13-24 months) in rural and urban settings were developed, based on literature, local surveys and meetings with national nutrition experts. Micronutrient intakes from usual diets were calculated as well as the potential contribution of four types of intervention: micronutrient fortification, micronutrient-enriched crops, micronutrient supplementation and locally available micronutrient-dense foods.

Results: Recommended Nutrient Intakes (RNIs) and Estimated Average Requirements (EARs) were not attained for most micronutrients by usual diets alone in WRA and children. Combination of supplementation and mandatory food fortification resulted in reaching the RNIs for pregnant/lactating women, while in non-pregnant/non-lactating women RNIs were only met for a few micronutrients, mainly in urban settings. Micronutrient coverage was lower in rural areas due to lower access to voluntary fortified foods products, and lower dietary diversity. In both countries, meeting the high micronutrient needs of children from 6 months remained a challenge. Breastmilk did not cover all micronutrient needs and the low diversity and frequency of the complementary diet did not fill the gap. Mass fortification strategies did not improve coverage as this is not adapted to young children. Specific complementary foods, dense in micronutrients, were the most efficient to improve the coverage of children's needs.

Conclusions: In women, better coordination of nutrition programs, including (bio-)fortification, supplementation and the promotion of nutrient-rich food, is warranted to reduce the high

prevalence of micronutrient deficiency while limiting the risk of overconsumption. In 6-23 mo children, quality and affordable first foods, complementary to breastfeeding, are essential to meet micronutrient needs and this supports the development of child-specific foods, based on micronutrient-rich available resources and efforts to increase dietary diversity particularly in the youngest children.

Keyword: Micronutrient deficiencies, West Africa, interventions, women, children

PAB(T6)-195
Evaluation criteria for flood monitoring portals: how to assess data quality and usability for nutrition and public health research?

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Background and objectives: Flood identification using satellite imagery has improved in recent years, with many flood monitoring portals now in existence. These data can be linked to nutrition and health surveys using spatial and temporal dimensions to measure household exposure to floods. A recent review study of publicly available nutrition data dashboards defined a set of evaluation metrics based on principles of evidence, efficiency, emphasis, and ethics. Using these metrics, we identify a set of evaluation criteria for assessing quality and usability of flood monitoring portals for nutrition and public health research.

Methods: We reviewed a set of 48 previously defined evaluation metrics for nutrition data dashboards and applied them to flood monitoring data portals. These metrics were developed based on standards of data and visualization quality. We selected and described the metrics that were applicable to evaluation of flood monitoring portals. We then applied these criteria to the assessment of 7 flood monitoring portals.

Results: A total of 24 metrics were identified as applicable to the evaluation of flood monitoring portals. These evaluation metrics were related to goals and scope, data quality including integrity, standardization, and granularity, platform capability, visualization quality, platform accessibility, communication, and conflicts of interest and responsible conduct. Granularity appeared to be the most important criteria to evaluate usability of flood monitoring portals for measuring household exposure to floods. Flood monitoring data portals provide an opportunity for an objective measure of household flood exposure but risk misclassification.

Conclusions: The suggested criteria allow to compare and standardize assessment of flood monitoring data portals and facilitate usability for studying effects of floods on nutrition, food security, and health outcomes. Our next step is to apply these metrics to the assessment of 7 flood monitoring portals for a study of recurrent flooding and household food access in Indonesia.

Keyword: Flood, Natural Disaster, Data Usability, Quality Metrics, Food Security

Conflict of Interest Disclosure: None

Further Collaborators: Dr. Aris Ismanto
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PAB(T6)-196
The Japanese dietary pattern and nutrient density: A cross-sectional analysis of NHANES 2017-2018

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Background and objectives: Several previous studies had shown that adhering to a Japanese diet is associated with better nutritional density. However, these previous studies were conducted only in Japan, and their generalizability is unclear. This study aimed to investigate the association between the Japanese dietary pattern and nutrient density among the US population.

Methods: Based on the National Health and Nutrition Examination Survey (NHANES) in 2017-2018, this study included 3,345 adults aged 20-80 years (1,556 men and 1,789 women) who were not pregnant or lactating women. Dietary intakes were assessed by the 24-hour recall method. The Japanese Dietary Index (JDI) score was calculated from 9 items (7 adhering items: rice, miso soup, fish, green and yellow vegetables, seaweed, pickles, green tea. 2 non-adhering items: coffee, beef and pork). The nutrient density (ND) index was calculated from 12 components of the Nutrient Rich Foods 9.3 Index based on "9 nutrients to encourage" (protein, fiber, vitamins A, C, E, calcium, iron, potassium, magnesium) and "3 nutrients to limit" (saturated fat, added sugar, sodium). We used the residual method to adjust the JDI score. Statistical analysis for correlations between items of JDI and ND index were performed using Spearman's correlation coefficients (ρ).

Results: The study sample included 1,253 (37%) non-Hispanic white, 744 (22%) non-Hispanic black, 750 (22%) Hispanic, 440 (13%) non-Hispanic Asian, and 158 (5%) non-Hispanic other. The JDI score was significantly correlated with the ND index (ρ = 0.155; p<0.001). The JDI score was positively correlated with all components in "9 nutrients to encourage" (range of ρ: 0.099 [vitamin E] to 0.376 [potassium]); p<0.001). The JDI score was negatively correlated with saturated fat and added sugar in "3 nutrients to limit" (ρ = -0.121 and -0.049; p = 0.005 and p<0.001), whereas the JDI score was positively correlated with sodium (ρ = 0.144; p<0.001).

Conclusion: The present findings suggest that adhering to a Japanese diet defined by the JDI score was associated with better

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

ND even among the US population. However, this dietary pattern also appears to be associated with high sodium intake as in previous studies of Japanese subjects.

Keyword: Cross-sectional study, Japanese diet, Nutrient density, Diet quality, Dietary pattern

PAB(T6)-197
What is the Iranian perception about genetically modified food? A content analysis study

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Background and Objectives: Increasing global population and diversity in consumption patterns have increased food consumption and demand and raised concerns about food supply in recent years. New advances in science and technology have developed ways to solve this problem, one of which is genetically modified food (GM foods). The purpose of this study is to explain the perceptions and perceptions of consumers about GM food products. **Materials and methods**: This qualitative study was performed by maximum variety sampling. Thirty adults aged 20 to 70 years living in Tehran (capital of Iran) were recruited in the study using in-depth interviews and 15 people were included in the study through focus group discussion. The coding process begun from the first interview and continued simultaneously with subsequent interviews. The initial concepts were emerged and by constant comparative analysis, the saturation of the concepts was followed. Participants sampling continued until data saturation. Data analyzed by directed content analysis using MAXQDA10 software. **Results**: People awareness on GM foods is relatively low and limited. Their sources of information were mostly the Internet and television programs, and the most important types of GM food products were oils, fruits and corn, rice and soy. According to the participants' views, the lack of exact determination criteria and TV advertisements are the shortcomings of information about these products. Based on the consumers' interpretation, GM foods are products that are manipulated by genes, hormonal changes, grafting and changing the molecular structure of production and have a different taste and appearance compared to normal products. **Conclusion**</str: From consumers' point of view, one way to reduce their anxiety was to have a label or clear sign based on the transgenic products in the stores so that consumers have more choice. Thus, it is concluded that proper use of the ability of the mass media, especially television, as well as suitable food labeling can contribute to this information.

Keyword: Genetically modified foods, Perception, Consumer, Qualitative study

Conflict of Interest Disclosure: There is no conflict of interest

Further Collaborators: No

PAB(T6)-198
Nutrition of the oysters aqua-cultured in the ecosystem of the Hiroshima Regional Urban Area

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Research background: Could the ecosystem including oyster culturing area produce oyster meat with higher quality, sustain better human health and improve preventive medicine? The law, *Revision of the Law Concerning Special Measures for Conservation of the Environment of the Seto Inland Sea and Modification of the Basic Plan for the Conservation of the Environment of the Seto Inland Sea* acted in 20115. Evaluation of the oysters have been performed nutritionally. **Materials and Methods:** Study areas are in the Hiroshima Regional Urban Area and Hiroshima Bay, Japan. Amino acid components in oyster meat were examined. And, two heavy metals, Cd and Zn, were measured in the marine sediments, river sediments, oyster meat, and oyster shells. **Results:** The cultured oysters contained carbohydrate and Zn with high levels. The total concentration of glucogenic amino acids was 69.6% of the total amino acid when measured by molecular volume. The sediment below oyster culturing rafts of Hiroshima Bay contained Zn and Cd: the mean value of Zn exceeded the maximum limit of sediment acceptable, and that of Cd was as high as those of 9 years ago. Commercially available oysters contained Zn in meat with as high levels as those of 50 years ago, which were as those of sediment and in shell as one tenth of the sediment. Oyster shell waste contained 0.005~0.32 mg/kg of Cd, which were as high levels as those in their meat. **Conclusion:** The fundamental solution would be to regain the sediment of lesser concentrations of Zn and Cd, which would restore the healthy Hiroshima Bay for oyster culturing, decrease viral infections through oyster meat, and conserve the ecosystem with landscape level.

Keyword: Cd, Ecosystem, Glucogenic amino acids, Oyster, Zn

PAB(T6)-199

Use of food additives in the Chilean food supply after the implementation of the Chilean Labeling Law, 2020

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Background and objectives: The use of additives in foods and beverages has increased with the growing participation of ultra-processed products in the diet worldwide. Despite regulations to set the maximum level of additives, there is concern that the increase and combination of additives might have health consequences in the long term. In 2016, Chile implemented a food labeling policy with improvements in the concentrations of sugars, saturated fats, and sodium in the packaged food supply. However, the food reformulation could also have increased the use of food additives. This study aimed to assess the distribution of food additives in the Chilean food supply.

Methods: We conducted a descriptive cross-sectional study with data from 14,038 packaged foods and beverages sold in the six largest supermarkets in Santiago, Chile, in 2020. We searched for all additives described by the Codex Alimentarius in the list of ingredients to identify their presence and describe the number of different additives per product.

Results: More than 70% of the foods products evaluated had at least one additive. The food categories with the highest proportion of items with additives were candies and confectionary (96.5%), bread and bakery products (90.3%), and dairy products (88.8%). A large part of the products used a combination of additives (61.6%). We found an average of 4.3 food additives per product, and 40.3% of them used a mix of five or more additives. Citric acid, lecithin, potassium sorbate, and sucralose were the most used additives, observed in more than 10% of the food items. Additives that change sensory aspects of the foods, a characteristic that defines a food product as ultra-processed, were prevalent in the Chilean market (67.1% of products). Emulsifiers were in 51.1%, flavoring agents in 46.8%, and colorants in 32.0% of the evaluated foods and beverages.

Conclusions: Food additives are widespread in packaged foods and beverages sold in Chile, and an important proportion of products use a mixture of different additives. Further analyses should explore the population consumption of food additives, and evaluate its association with health outcomes, especially metabolic disorders.

Keyword: Food additives, Ultra-processed foods, Chile

PAB(T6)-200

Overweight/obesity, hypertension, diabetes and dyslipidaemia among adults (>=18 years) from Maharashtra State, India

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Background & Objective: Nonـcommunicable diseases are the important cause of morbidity and mortality globally, The study was undertaken to assess prevalence of overweight/obesity, hypertension, diabetes and dyslipidemia among adults, **Methods**: A community-based cross-sectional study was carried out in five cities including capital city of Maharashtra as part of National survey, Information was collected on household's socio-economic & demographic particulars. Anthropometric measurements such as height (cm), weight (kg), waist and hip circumferences, blood pressure, fasting blood sugar and lipid profile were measured on all the selected adults, Association between overweight/obesity, hypertension and diabetes with socio-demographic and other variables was tested using Chi-square and logistic regression was done, Total 6,933 adults were covered from 3,526 HHs. **Results**: The prevalence of overweight/obesity (BMI≧25) was 45.6% (M:38.5%, F:51.6%), hypertension was 38.8% [M:43.4% (41.7 - 45.1), F:34.9% (33.4 - 36.4)] (age adjusted 33.9% & 28.1%), diabetes 27.4%, [M:28.4% (26.6-30.2), F:26.5%, (24.9-28.1)], (age adjusted 19.6% & 19.9%) respectively, The prevalence of pre-hypertension was 38%, (men:39.6%; women:37.3%), The prevalence of hypercholesterolemia, & hyper-triglyceridemia was 27.6% & 35.7%. About 97% were aware of hypertension, 16% had past history of hypertension and all of them were on treatment, The prevalence of hypertension was observed high among elderly (66%) as compared to 18-35 years (16%), among men (43.4% vs 34.9%), belonging to high income group (45% Vs 35.5%), hyper-cholesterolemia (50.8%), hyper-triglyceridemia (50.3%), among diabetics (60%), and among overweight/obese (49%), On step-wise logistic regression, odds of hypertension was high among overweight/obese (OR:4.05; CI=1.87-8.76), with abdominal obesity (OR:1.37; CI=1.04-1.80), among diabetics (OR:1.70; CI=1.36-2.12), and among high cholesterol (OR:1.55; CI=1.24-1.95) while, the risk of diabetes was among high income groups (OR:1.52; CI=1.15-1.99), with abdominal obesity (OR:1.51; CI=1.17-1.95), among hypertensive (OR:1.68; CI=1.34-2.10) and with high triglyceridemia (OR:2.23; CI=1.78-2.78) **Conclusions**: The prevalence of hypertension and diabetes was high and was significantly associated with per capita income, overweight/obese, abdominal obesity and hyper-cholesterolemia and triglyceridemia. There is an urgent need to strengthen ongoing national program for prevention and control of cancer, diabetes, cardiovascular diseases and stokes (NPCDCS) for early screening for diagnosis and treatment and health & nutrition education may be strengthen for prevention & control of non-communicable diseases.

Keyword: Overweight/obesity, Hypertension, Diabetes, Dyslipidemia

Conflict of Interest Disclosure: Nil

Further Collaborators: Nil

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-201

Effect of weight loss on improving laboratory test values by using health guidance in men with metabolic syndrome

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Background and purpose: We examined the effect of weight loss by improving lifestyle habits in consideration of age.

Methods: Among individuals who underwent a health checkup at a specific medical institution in 2017 and 2019, 5,747 Japanese men, aged 19–72 years (i.e., baseline), who had no medication use, pre-existing illness, or data loss were included in the analysis. Between the weight gain group (n=2,930) and the weight loss group (n=2,844) who gained weight between 2017 and 2019, and the weight loss group (n=1,112) who achieved 3% or more of the weight loss group. Abdominal circumference, blood pressure, serum lipid between the non-3% or more weight loss achieved group (n=1,732), the weight loss group of 4 kg or more (n=620) and the non-4 kg or more weight loss achieved group (n=2,224). Changes in lipid-based test values were compared.

Results: The weight loss group had an improvement in or tended to have an improvement in the levels of triglyceride, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol, and blood pressure at the endpoint, compared to the baseline values. Furthermore, among the weight loss groups, the group that achieved a weight loss of 3% or more and the group that achieved a weight loss of 4 kg or more were significantly classified into the age groups of under 40 years, 40s, 50s, and 60 years old or older. An improvement was noted. Among these individuals, the findings also clarified that the younger the age, the more remarkable was the improvement.

Conclusion: The younger the population, the stronger was the improvement in laboratory test values in association with weight loss. If a person is judged as having metabolic syndrome, based on health checkup findings, then promoting weight loss measures by improving lifestyle habits as early as possible is necessary.

Keyword: weight loss, health guidance, metabolic syndrome, Japanese men

PAB(T6)-202

Relationship between dietary patterns with subjectively measured physical activity in 85+ years older.

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Background and objectives: It is defined as healthy behaviors (Hbs) such as a better-quality diet and exercising regularly. HBs are associated with many health outcomes and are expected to improve quality of life and increase life expectancy. While the maintenance of HBs is essential in an aging society, the relationship between dietary patterns (DPs) and physical activity (PA) is less known. Furthermore, there is no knowledge of the relationship between the two in the population aged 85 years and older, so this study was a cross-sectional investigation of the relationship between both.

Methods: This study used baseline data from The Tokyo Oldest Old survey on Total Health (TOOTH) Study conducted in 2008 – 2009, JAPAN. The Diet survey used brief-type self-administered diet history questionnaire (BDHQ) to estimate the intake of 55 foods. After energy adjustment, principal component analysis (PCA) was performed to identify major DPs. PA was using a questionnaire that has been validated for this age group. This study used three outcomes: walking, exercise (e.g., calisthenics and resistance training), and PA index (PAI, the sum of these activities, METs*hour/week). The association between DPs and PA were examined in a general linear model, considering various confounders.

Results: A total of 519 subjects (median age: 87.3 years; male: 42.2%) were included in the analysis, excluding those with missing BDHQ. Three major DPs (DP1: various plant foods, DP2: fish and mushrooms, DP3: cooked rice and miso soup) were identified from PCA. DP1 was similar to DPs previously named "healthy" or "prudent". A positive association was observed between the trend of DP1 and higher PAI (1.41, 0.33 – 2.48 (B, 95%CI)). The results also suggested a relationship with exercise but not walking.

Conclusion: This study observed the implementation of HBs even among those aged 85 years and older, suggesting that a trend toward a healthier, more food-diverse DP is associated with higher PA. Future studies should examine the outcomes of the implementation of HBs.

Keyword: aging population, healthy behaviors, dietary pattern, physical activity, principal component analysis

Conflict of Interest Disclosure: No.

Further Collaborators: No.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-203

Association between screen time, including that for smartphones, dietary habits, and overweight/obesity among children in Japan.

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Background and Objectives: The association between screen time (ST), including that for smartphones, and overweight/obesity in children was examined separately for boys and girls, considering the influence of lifestyle factors including diet, physical activity, and sleep time.

Methods: A cross-sectional study was conducted in 2242 Japanese children (1278 girls) aged 10-14 years. Overweight/obesity was defined by the International Obesity Task Force. Lifestyle habits such as ST, sleep time, physical activity and dietary habits were surveyed using a questionnaire.

Results: Logistic regression analysis showed that only for girls, total ST (≧4h), smartphone ST (≧3h) and non-smartphone ST (≧2h) were all independently and significantly associated with overweight/obesity compared to <2h total ST, non-use of smartphones, and <1h non-smartphone ST. The latter two were additively associated with overweight/obesity at ST ≧3h and ≧2h, respectively. In other words, girls having smartphone ST ≧3h and non-smartphone ST ≧2h were 6.80 times (95% CI: 3.11-14.84) more likely to be overweight/obesity than girls with less usage of both devices. In girls, compared to total ST <4h, smartphone ST <3h, and non-smartphone ST <2h, ≧4h, ≧3h, and ≧2h had significantly more beverage consumption and breakfast skipping in common, and the former two were significantly more likely not to eat breakfast or dinner with their families. In addition, none of these associations were significant in boys.

Conclusions: In Japanese girls, smartphone ST, non-smartphone ST, and total ST were all significantly associated with overweight/obesity. In addition, those with shorter ST had fewer dietary habits that could contribute to overweight/obesity. To avoid overweight/obesity, it is suggested to keep smartphone ST, non-smartphone ST, and total ST to <3h, <2h, and <4h.

Keyword: Screen time, Overweight, Obesity, Childhood obesity, Dietary habits

PAB(T6)-204

Biofortification scale-up as a strategy to mitigate food shortages and increase nutrient intake during COVID-19 in a maternal and child health and nutrition program in Bangladesh, Kenya, Myanmar and Tanzania.

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Background and Objectives: ENRICH-MNCH project targeted 4.1 million individuals including 1.8 million women and adolescent girls 10-49 years, through gender-responsive efforts to slow and contain the spread of COVID-19 while mitigating aftershocks and secondary nutrition, health and social impacts in the target areas of Bangladesh, Kenya and Tanzania. The project scaled up the ongoing biofortification promotion to address food shortages and inadequate nutrient intake exacerbated by the COVID-19 pandemic. The initiative also complemented the Ministry of Health and other line ministries'COVID-19 preparedness activities, including stockpiling of the necessary medicine, equipment and supplies, orientation, and training of health workers, identifying isolation facilities, conducting community sensitization and engagement, strengthening of national and regional laboratories, infection prevention and control, and surveillance in the communities.

Methods: The project strengthened community-based social services and structures to minimize the gendered impact of the pandemic on nutrition and health systems, social services, and economic activity, particularly for women and girls.

Results: Biofortified crops were promoted in in the target countries with support from HarvestPlus and local organizations. In Bangladesh, five varieties of zinc-fortified rice were introduced through 6,155 demonstration plots and 581 farmers received training. Due to COVID-19 public health measures, small neighbourhood meetings were used to reach farmers. The project distributed 427.9 metric tonnes of zinc rice seeds to 115,774 families in Bangladesh. In Kenya 70 metric tons of seeds of high-iron beans was distributed to households with children under two years of age. In Tanzania, 10 million Orange Fleshed Sweet Potato (OFSP) vines of were distributed to households with pregnant women and children under two years of age. Overall, 41,087 families were reached with beans while 24,976 were reached with OFSP in Kenya, and 23, 476 families were reached with OFSP in Tanzania.

Conclusion: Promotion of biofortified crops is one of the strategies which can be scaled up to address food shortages and inadequate nutrient intake during emergency situations.

Keyword: Biofortification, High Iron Beans , Orange Fleshed Sweet Potato, Zinc Rice

Conflict of Interest Disclosure: I have no conflict of interest to declare.

Further Collaborators: ENRICH Project was funded by the Government of Canada through the Global Affairs Canada.

PAB(T6)-205
Reducing red meat consumption for climate mitigation: is the US population making the cut?

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Background and objectives: Reducing meat consumption was identified in the Intergovernmental Panel on Climate Change Sixth Assessment Report as a key response option for climate change mitigation, given its high environmental footprint. The US has among the highest meat intakes globally. Reducing red meat consumption should be a priority in the US, yet little is known about what influences people to consume less. The objective of this study was to examine factors that influence consumers to shift red meat consumption in the US.

Methods: We conducted an online survey (n=1224) in July-September 2021 with a representative sample of the US population. The survey included questions about socio-demographics, frequency of both unprocessed and processed red meat consumption in past 7 days and changes to red meat consumption patterns over the previous year. Participants who reported reducing their meat consumption were asked to identify factors that influenced those changes. We report multivariable binary logistic regression results about unprocessed/processed red meat consumption and utilized survey weights to represent the US population.

Results: Most participants reported consuming red meat (78% unprocessed; 74% processed) 1-4 times per week. Overall, 68% of participants reduced consumption of unprocessed, and 62% reduced consumption of processed, red meat. Twenty-seven percent of participants ≧65 years were unprocessed/processed red meat reducers, as compared to 5-6% of participants 18-24 years old. Participants who did not report eating red unprocessed/processed meat at all and those consuming unprocessed meat 1-4 times in the past 7 days had higher odds of being meat reducers compared to those consuming unprocessed/processed red meat ≧5 times in past 7 days. Health was the most identified factor influencing red meat reduction (66% unprocessed; 63% processed), followed by price (32% unprocessed; 23% processed). Only 6% reported reducing unprocessed/processed red meat due to environmental sustainability concerns.

Conclusions: Our findings suggest that a significant proportion of the US population may be reducing their red meat consumption but that it is primarily driven by health rather than environmental concerns. Emphasizing the health aspects of red meat reduction among the US population may increase the likelihood of shifting food choices towards more sustainable diets.

Keyword: sustainable diets, red meat, climate mitigation, food choice

Conflict of Interest Disclosure: None to declare

PAB(T6)-206
Regional difference in effect of food store accessibility on vegetable and fruit acquisition and healthy eating behaviors for older adults

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Background and objectives: Since the regional contextual environment of urban and rural areas is different, the effect of the food environment in these areas on dietary intakes would be different. This study aimed to examine whether accessibility-based food environmental factors influence on vegetable and fruit acquisition and healthy eating behaviors in different areas, using a nation-wide data set.

Methods: This study is based on the data from the 2019 Consumer Behavior Survey for Food (CBSF) provided by the Korea Rural Economic Institute (KREI). The subject is older adults aged ≧ 65 years (n 830) who participated in the CBSF. Food environment was assessed by perceived food store accessiblity questionnaires. The vegetable and fruit acquisition included frequency of daily purchases and non-purchased sources and healthy eating behaviors were evaluated by three items of moderation, variety and eating healthy foods. **Results:** Insufficient food store accessibility was related to low vegetable and furit acquisition and poor healhty eatign behvaiors. Amogn food store accessibility, specifically, rural older adults who perceived insufficient physical accessibility were more likely to have low vegetable and furit acquisition (OR: 2.34 95% CI: 1.27-4.32 for vegetable and 1.96, 95% CI: 1.02-3.75 for fruit). OR: 2.34 95% CI: 1.27-4.32). For those who perceived that only one of the two accessibility is insufficient, the urban older adults were less likely to have various and healthy food eating when they perceive insufficient economical accessibility acquisition (OR: 0.47, 95% CI: 0.25-0.90 for variety and 0.23, 95% CI: 0.11-0.46 for eating healthy foods) but rural older adults were less likely to have when they perceive insufficient physical accessibility (OR: 0.49, 95% CI: 0.21-0.97 for variety and 0.28, 95% CI: 0.13-0.63 for eating healthy foods).

Conclusions: The food store accessibility environment affected healthy food acquisition and healthy eating behaviors in older adults. The dimentsion of food store accessibility that affected food acquisition and eating behaviors was different by region.

Keyword: Food store accessibility, Region, Vegetable and fruit acquisition, healthy eating behavior, Older adults

Conflict of Interest Disclosure: There is no conflict of interest

Further Collaborators: The funding for this study was provided by the National Research Foundation of Korea (NRF-2019R1A2C1084372 and NRF-2021R1I1A3049883).

PAB(T6)-207

Access to sufficient and safe drinking water and health outcomes in Ghana: Results from UNICEF-MICS6 survey

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Background and objectives: Water is an essential nutrient. It is also a critical component in maintaining food production, access, and utilization. However, according to the WHO/UNICEF 2021 report, about 2 billion people globally lack access to safe drinking water. Most of these people are living in Sub-Sharan Africa and Asia. Ghana has made significant progress in expanding water services, but still a significant proportion of the country's population use unimproved drinking water source. Hence the objectives of this study were to 1) Examine sociodemographic predictors of drinking water quality in rural and urban households, and; 2) Determine the relationship between water quality and incidence of diarrhea among u children.

Methods: A secondary data analysis was carried out using the Ghana UNICEF-MICS6 survey. Data were analyzed using R software. The survey package in R took into consideration the strata, principal sampling units, and sampling weights. Bivariate and multivariate analyses were carried out using the statistical significance of $p \leq .05$.

Results: Among the 12,886 households interviewed, 88.4% used improved source of drinking water including piped water, tube well or borehole and packaged/delivered water. Contamination of drinking water with *Escherichia coli* (*E. coli*) was significantly higher among rural compared to urban households irrespective of the source of water (improved vs unimproved, β±SE: 6.1±2.3, p = 0.008). By wealth index, the highest quintile households were associated with lower *E. coli* count in drinking water compared to the poorest quintile (β ± SE: -9.3±4.4, p = 0.03). After controlling for potential cofounding variables, child diarrhea incidence was predicted by maternal/caretaker education and age of child, but not water quality.

Conclusions: In Ghana, rural and poor households are significantly affected by poor water quality. In future, an in-depth investigation on water fetching, storage, handling and frequency of hand washing, and sanitation services is warranted to examine pathways through which fecal contamination is likely to occur and what behavior change and interventions are critical to meet the SDG 6 target of ensuring safe and clean drinking water at the household level.

Keyword: water quality, Child health

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-208

The association of sunlight exposure with sleep quality among pregnant women in Kuala Lumpur, Malaysia.

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Background and objectives: Sleep quality deteriorates during pregnancy due to physical and hormonal changes in the body. Previous studies have found that sunlight exposure is beneficial for emotional wellbeing and sleep health. This study aims to determine the role of sunlight exposure on sleep quality of pregnant women in Kuala Lumpur.

Methods: This cross-sectional study was conducted in 9 randomly selected government maternity clinics in Kuala Lumpur. Healthy women aged 19-39 with single pregnancy were recruited using convenience sampling. The participants were required to wear a UVB dosimeter pinned on their shoulders for 2 weekdays and 1 weekend day to determine sunlight exposure. Sunlight exposure was expressed in standard erythemal dose (SED). Sleep quality was self-reported using the Pittsburgh Sleep Quality Index (PSQI).

Results: A total of 86 pregnant women participated in this study with average age of 27.74 ± 3.17 years. The total SED was 0.04 (IQR=0.10). Prevalence of participants with poor sleep quality was 62%, with mean sleep duration of 6h 56m ± 1h 33m. Sunlight exposure was negatively correlated with global PSQI scores (ρ=-0.311 p=0.004), subjective sleep quality (ρ=-0.256, p=0.017), sleep latency (ρ=-0.258, p=0.017) and sleep disturbance (ρ=-0.247, p=0.022). Adjusted multiple linear regression revealed that higher sunlight exposure was associated with good sleep quality (β= -0.332, p=0.003), higher subjective sleep quality (β= -0.297, p=0.009), and lower sleep latency (β= -0.232, p=0.039).

Conclusion: From this study, participants who had low sunlight exposure were found to have poor sleep quality. Sunlight exposure is closely related to sleep quality during pregnancy. The study findings may act as a guide for future interventional studies to improve sleep quality among pregnant women by controlling sunlight exposure for favourable mother and infant health outcomes.

Keyword: Sunlight exposure, Sleep quality, Pregnancy, Sleep duration, UVB light

PAB(T6)-209
Spatial Distribution and Correlates of Child Nutrition in Gujarat, India

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Background and Objectives- Although the recently released National Family Health Survey -5 (NFHS-5, 2019-2020) data show a significant improvement in maternal nutrition and health indicators, India continues to suffer from a high prevalence of child undernutrition. Gujarat is a progressive state, but its maternal and child nutrition and health indicators are poor. The goal of this study was to look at spatial heterogeneity, factor clustering associated with maternal, and child health indicators at the district level in Gujarat, India. **Methodology** - Secondary source data on child undernutrition indicators and associated maternal factors were used at the district level from NFHS 4 (2015-16) and NFHS 5 (2019-2020). Spatial thematic mapping in Arc GIS was used to map the spatial distribution of indices from 2015-16 to 2019-2020. To investigate the factors associated with these indices, Pearson's Correlation Model was used. **Results** - The findings indicate that districts in the north-western geographical region have improved maternal indicators such as antenatal care (ANC), whereas districts in central Gujarat experienced decline or stagnation. Institutional births increased significantly in almost all regions of Gujarat, except for Dangs, a tribal district. The prevalence of diarrhea and acute respiratory infection have shown a marginal decrease. The western region made strides in terms of breastfeeding initiation. Prevalence of stunting, wasting, and being underweight among children under the age of five has remained unchanged in Gujarat from 2015-to 16. The prevalence of wasting, underweight, and anemia in children (6-59 months) increased in the northeastern districts. The Geographically Weighted Regression shows a significant association between female literacy, women's nutritional status (low BMI, overweight/obesity), maternal anemia, sanitation and drinking water sources, institutional births, and antenatal care with undernutrition in children (6-59 months). The weighted sum analysis identified clusters with a high burden of undernutrition in the southeast region and clusters with a low burden in the northwest region of the state.

Conclusion- Spatially targeted District level strategies to improve literacy among women, reduce maternal under-nutrition and anemia, and promote sanitation and hygiene will improve the maternal and child health indicators in high burden districts of Gujarat.

Keyword: Spatial distribution, Maternal undernutrition, Child undernutrition, Clusters of undernutrition, Correlates of undernutrition

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-210
Association of spot urine sodium-to-potassium ratio with dietary salt and intake of vegetables in male Japanese bus drivers

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Background and objectives: The aim of this study was to examine the association of the spot urine sodium-to-potassium (Na⁄K) ratio with dietary salt and intake of vegetables in male Japanese bus drivers.

Methods: A cross-sectional study was performed in 492 male Japanese bus drivers (19-70 years old) working at a transportation company in Ishikawa Prefecture. The 24-h urinary Na⁄K ratio was estimated from a formula using collected spot urine. A self-administered questionnaire was used to assess daily intake of vegetables and a salt check sheet was developed by Tsuchihashi et al. during health examinations in the summer of 2020. The participants were grouped into four categories based on their 24-h urinary Na⁄K ratio: Group I, n=73, <3; Group II, n=218, ≧3 to <4; Group III, n=146, ≧4 to <5; and Group IV, n=55, ≧5. Associations of laboratory test results, health-related behaviors, and dietary salt and vegetable intake with the four 24-h urinary Na⁄K ratio categories were examined. This study was approved by the ethics committee of Osaka City University Graduate School of Human Life Science.

Results: There were no significant differences (at the 5% level) in age, height, body weight, and diastolic blood pressure among the groups. In the JSH2019 blood pressure classification, the percentage of participants with high blood pressure, including those taking medication, was highest in Group IV, although this difference was not significant. The estimated 24-h urinary sodium and salt excretion and the salt check sheet score were significantly higher and the estimated 24-h urinary potassium excretion was significantly lower in Group IV compared to the other three groups. Daily intake of vegetables did not differ significantly among the groups, but was significantly higher at dinner than at breakfast and lunch.

Conclusions: These results indicate that a high urinary Na⁄K ratio has a high risk of hypertension. This suggests that there is a need to provide dietary guidance to increase vegetable intake while reducing salt.

Keyword: spot urine Na/K ratio, vegetables, salt

PAB(T6)-211
Examination of the relationship between abdominal circumference and BMI in Japanese women

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Background and Purpose: In Japan, medical checkups focusing on metabolic syndrome are conducted. The standard for women uniformly is an abdominal circumference of ≧90 cm or a body mass index (BMI) of ≧25 kg/m². We examined the relationship between abdominal circumference and BMI in Japanese women, based on age group and height group.

Methods: The study participants were 28,598 women, aged 30-59 years, who had undergone a medical examination in 2019, were not on medication, and did not have a medical history or missing data. Using the values of abdominal circumference, height, and BMI, the patients were classified according to age group and height group. The criteria for abdominal circumference was <90 cm or ≧90 cm and the criteria for BMI was <25 kg/m² or ≧25 kg/m². Height was classified into four groups: <150 cm, ≧150 and <160 cm, ≧160 cm and <170 cm, and ≧170 cm.

Results: At all ages, the percentage of women with an abdominal girth of ≧90 cm tended to increase with increasing height group. The percentage of women with an abdominal girth of ≧90 cm and a BMI of ≧25 kg/m² similarly increased with a marked increase among women in their 50s. However, the percentage of women with an abdominal circumference of <90 cm and a BMI of ≧25 kg/m² decreased. Among women in their 30s and 40s, the percentage of women with an abdominal circumference of <90 cm and a BMI of <25 kg/m² increased with increasing height. Furthermore, even within the same height group, the proportion of women with an abdominal girth of ≧90 cm increased with increasing age.

Conclusion: The relationship between abdominal circumference and BMI, based on height, was similar in all age groups but was more pronounced in women in their 50s. When Japanese women age from their 40s to their 50s, clinicians and dietitians should be aware that abdominal circumference and BMI increase rapidly, especially among women whose height is ≧170 cm.

Keyword: Japanese women, medical checkup, abdominal circumference, BMI

PAB(T6)-212
Nutrient Profiling and Environmental-Impact Profiling in Processed Food Products: An exploratory analysis of Nutri-Score, Thailand Healthier Choice and Eco-Score

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Background and objectives: The sustainability of food systems turns out to be a highly critical question with various nutritional and environmental challenges. Regarding food and nutrition, nutrient profiling for front-of-pack (FOP) nutritional labeling aims to classify food healthiness by its nutrient composition. Besides, environmental-impact profiling purposes to capture and differentiate the environment-friendliness by the environmental footprint of food products. This study aims to investigate the association between nutrient profiling (as assessed by Nutri-Score and Thailand Healthier Choice) and environmental-impact profiling (as assessed by Eco-Score) in processed food products.

Methods: The database was obtained from the Open Food Facts database. The ultimate of 84,455 processed food products were incorporated into this investigation. 'Healthier' and 'Less healthy' products were independently analyzed by the algorithm of Nutri-Score and THCL. Especially, 'Healthier' products were interpreted as receiving grade A, B, and C (by Nutri-Score) or passing the nutrient threshold of saturated fatty acids, trans-fatty acids, sodium, sugars, energy, and fiber (by Thailand Healthier Choice), whereas 'Less healthy' items were defined of carrying Nutri-Score grade D and E or disqualified with the THCL nutrient criteria. Eco-Score points for each food were computed with a Life Cycle Assessment and were available in the database. The association and relationship between the two systems was carried out using Mann-Whitney tests and simple correspondence analysis appropriately.

Results: The majority of surveyed products had an Eco-Score of grade D (37.2%), followed by grade B (27.4%), and grade C (23.3%). The median and interquartile of Eco-Score points in investigated products were 41.0 (31.0-62.0). 'Healthier' products classified by both Nutri-Score and Thailand Healthier Choice criteria were significantly associated with a lower environmental footprint ($p<0.001$), rating ranging from 44 to 54% in Eco-Score category B, 21 to 26% in category C, and 26 to 30% in category D depend on the distinct scheme.

Conclusions: Among our investigated products, 'Healthier' products classified by either Nutri-Score or Thailand Healthier Choice nutrition labeling scheme presented a lower environmental footprint, compared to less healthy items. This exploratory study highlights the need for further studies and focuses on the evaluation of the sustainability of FOP nutrition labeling as well as the industrial food system in order to achieve a win-win solution in environmental and nutritional improvements.

Keyword: FOP Nutrition Labelling, Environment Footprint, Nutrient Profiling, Sustainability Food System, Processed Foods

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

PAB(T6)-213
Quality of Beverage Intake and Cardiometabolic and Kidney Outcomes: Insights From the STANISLAS Cohort

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Background and Aims: Beverages are an important aspect of diet, and their quality can possibly affect health. The Healthy Beverage Index (HBI) has been developed to take into account these effects. This study aimed to highlight the relationships between health and beverage quality by assessing the association of the HBI and its components with kidney and cardiometabolic (CM) outcomes in an initially healthy population-based familial cohort.

Methods: This study included 1,271 participants from the STANISLAS cohort. The HBI, which includes 10 components of habitual beverage consumption, was calculated. Associations of the HBI and its components with estimated glomerular filtration rate (eGFR), albuminuria, hypertriglyceridemic waist (HTG waist), metabolic syndrome (MetS), carotid-femoral pulse wave velocity (cfPWV), carotid intima-media thickness (cIMT), and left ventricular mass (LV mass) were analyzed using multivariable linear or logistic regression models.

Results: The median HBI score was 89.7 (78.6–95) out of 100 points. While the overall HBI score was not significantly associated with any of the studied outcomes, individual HBI components were found differently associated with the outcomes. cfPWV and cIMT were lower in participants who did not meet the full-fat milk criteria (p = 0.03 and 0.001, respectively). In men, higher cfPWV was observed for the "low Fat milk" (p = 0.06) and "alcohol" (p = 0.03) non-adherence criteria. Odds of HTG waist were higher with the non-adherence to sugar-sweetened beverages criteria (p < 0.001). eGFR was marginally higher with non-adherence to the coffee/tea criteria (p = 0.047).

Conclusions: In this initially healthy population, HBI components were differently associated with kidney and cardiometabolic outcomes, despite a good overall HBI score. Our results highlight specific impacts of different beverage types and suggest that beverages could have an impact on kidney and cardiometabolic health

Keyword: beverages, kidney function, cardiovascular health, metabolic health, Healthy Beverage Index

Conflict of Interest Disclosure: None for the present work

Further Collaborators: Erwan Bozec, Laurie Van den Berghe, Mehmet Kanbay, Céline Cakir-Kiefer, Ludovic Mercklé

PAB(T6)-214
Association of Dietary Na/K Ratio with Intake of Nutrients in Japanese Children Aged 3-5 Years Old

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Background and Objectives: Several studies in Japanese adults have suggested that a high dietary Na/K ratio increases the prevalence of stroke. However, there have been few reports of the dietary Na/K ratio in Japanese children. The aim of this study was to examine the association of dietary Na/K ratio (high or low) with the intake of energy and nutrients in Japanese children. **Methods:** The participants were 225 Japanese nursery school children (126 boys, 99 girls; age 3-6 years). A dietary survey was conducted over three non-consecutive days comprising two days with a school lunch (i.e., weekdays) and one day without a school lunch (i.e., a holiday) in each season (i.e., 12 days in total in one year) using the semi-weighted dietary record method. Participants were divided into groups based on their Na/K ratio (high or low, using the median as a cutoff), with different pairs of groups established based on gender and for weekdays and holidays. Intake of energy and nutrients were compared in these groups. **Results:** For boys, the mean Na/K ratios in the low and high groups were 2.08 and 2.84 on weekdays, and 2.36 and 3.55 on holidays, respectively. The low group had significantly higher mean intake of energy, protein, calcium, iron, vitamin B_1 and dietary fiber on weekdays, and of vitamin A and vitamin C on holidays. For girls, the mean Na/K ratios in the low and high groups were 1.99 and 2.82 on weekdays, and 2.15 and 3.30 on holidays, respectively. The low group had significantly higher mean intake of energy, carbohydrates, calcium, vitamin A, vitamin B_1, vitamin B_2, vitamin C and dietary fiber on weekdays, and of calcium, vitamin A, vitamin C and dietary fiber on holidays. **Conclusions:** Children with a lower Na/K ratio generally had significantly higher intake of vitamins and minerals. These findings suggest that maintenance of a low dietary Na/K ratio leads to desirable nutrient intake.

Keyword: Na/K ratio, nursery, Japanese children, dietary survey

PAB(T6)-215

Cardiometabolic risk of women caregivers living in fishing communities along the four coastal regions of Ghana.

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Background and Objectives: Cardiovascular disease and diabetes continue to increase globally. This study assessed the cardiometabolic risk of caregivers living along the four coastal regions (Greater Accra (GAR), Volta (VR), Central (CR), and Western (WR)) of Ghana using simple anthropometric and body composition indicators.

Methods: 1120 women caregivers between 15 and 49 years were recruited from 16 communities (4 per region). Anthropometric measures of height, weight, hip, and waist circumference (WC) were obtained and used to determine body mass index (BMI), waist to hip ratio (WHR), and waist to height ratio (WHtR). Percent body fat (PBF), visceral fat (VF), skeletal muscle (SM), and resting metabolism (RM) were determined using a body composition scale. All measures and indicators were compared across regions at a significance level of $p < 0.05$.

Results: 1001 caregivers completed the assessment. Significant differences were observed across regions for WC, BMI, PBF, VF, SM, WHR and WHtR. Many caregivers were at an *increased risk of metabolic complication* (WC > 0.80) – GAR=73.1%, VR= 71.5%, CR= 64.3%, WR= 64.6%. Whereas majority had a *substantially increased risk* of cardiovascular disease (CVD) and diabetes, (WHR > 0.85) – GAR= 63.8%, VR= 57.0%, CR= 51.4%, WR= 54.8%, more than a third had an *increased risk* (WHtR ≧ 0.5 and < 0.6) – GAR= 43.8%, VR= 46.8%, CR= 51.4%, WR= 54.8%. Over a third had a *normal* BMI (BMI ≧ 18.5 and ≦ 24.9kg/m^2) – GAR=38.8%; VR= 46.4%, CR= 47.8%, WR= 41.4%. However, a large majority had a *normal* VF (VF ≦ 9%) – GAR= 82.7%, VR= 85.5%, CR= 96.1%, WR= 94.1%.

Conclusions: Most caregivers living in fishing communities along the four coastal regions of Ghana were at risk of cardiovascular diseases and diabetes. Culturally appropriate interventions are required to reduce cardiometabolic health risks and improve quality of life.

Keyword: Nutrition, Cardiovascular disease, Obesity, Body composition, Anthropometric indices

PAB(T6)-216

Skin carotenoid levels and metabolic syndrome in a general Japanese population: the Hisayama Study

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Background and objectives: A higher vegetable intake is being promoted as an initiative to prevent lifestyle-related diseases such as obesity and metabolic syndrome. Carotenoids are yellow or red pigment components and are widely present in plants, mainly included in vegetables. Since ingested carotenoids accumulate in the skin, skin carotenoid levels are a good indicator of vegetable intake. Recently, a non-invasive optical sensor for assessing skin carotenoid levels has been developed and its measured values have been verified to be highly correlated with serum carotenoid levels. Herein, we examined the association of skin carotenoid levels estimated by the noninvasive optical sensor with the presence of metabolic syndrome.

Methods: A total of 1,619 individuals (604 men and 1,015 women) aged ≧40 years (mean age 63.1 years) participated in the study. Skin carotenoid levels were measured by the optical sensor based on multiple spatially resolved reflectance spectroscopy. The definition of metabolic syndrome was based on the Joint Scientific Statement by six international scientific societies (Alberti KG, et al. Circulation. 2009;120:1640-1645). The multivariable-adjusted logistic regression models were used to analyze cross-sectional association between skin carotenoid level and the presence of metabolic syndrome.

Results: The prevalence of metabolic syndrome was 31.3 % (n = 506). Higher skin carotenoid levels were associated remarkably with lower likelihood of metabolic syndrome after adjusting for confounders (*P*-trend <0.001). Multivariable-adjusted odds ratio for the presence of metabolic syndrome in individuals with the highest quartile of skin carotenoid level was 0.39 (95 % confidence intervals 0.28-0.55) compared to those with the lowest quartile. With regard to each component of metabolic syndrome, the odds ratios for the presence of abdominal obesity, hypertriglyceridemia, elevated blood pressure, elevated blood glucose decreased significantly with higher levels of skin carotenoids (all *P*-trend <0.001).

Conclusions: Our findings suggest that higher skin carotenoid levels are significantly associated with lower likelihood of metabolic syndrome and its components in a general Japanese population. Skin carotenoid levels estimated by the noninvasive optical sensor may be useful in the assessment of the daily vegetable intakes and the dietary guidance for individuals to prevent metabolic syndrome.

Keyword: skin carotenoids, metabolic syndrome, non-invasive measurement, cross-sectional study, vegetable intake

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-217

Barrners and enablers to healthy and sustainable food systems in Ethiopia: Qualitative study

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Background and objective: Healthy and sustainable food systems is indispensable for combating the triple burden of malnutrition. Without improving the food systems, the efforts to control multiple forms of malnutrition would be undermined. The purpose of this study is to identify the barriers and enablers for healthy and sustainable food systems in Ethiopia.

Methods: A qualitative study was used to explore the barriers and enablers of various sub-components of the food systems. The study was designed in such a way that the perspectives of rural and urban dwellers and agrarian and pastoral livelihoods of Ethiopia are represented. The study captured the views federal and regional level informants as well. Data were gathered through Focus group discussions (FGDs) and key informant interview (KIIs). More than 60 KIIs with decision makers, researchers and academicians were conducted. Twelve FGDs were organized with urban consumers, farmers, youth and women's group.

Results: The major enable to the national food systems is the presence of comprehensive policy environment. Nutrition is also enjoying increasing attention by various stakeholders. Currently multisectoral nutrition interventions including Nutrition Sensitive Agriculture and social protection programs are being implemented at scale. The government has adopted promising strategic directions, including cluster farming and lowland wheat initiative for boosting production. The Integrated Agro-industrial Parks initiative helps to modernize the value chain and reduce food loss. Presence of the Health Extension Program platform offers a special opportunity for promoting nutrition literacy and implementing nutrition programs at grassroots level. However, the food systems is constrained by multiple barriers including: lack of political stability, uncontrolled population growth, subsistence rain-fed agriculture, lack of support to large-scale farming, weak agricultural cooperatives, uncontrolled food price, uncontrolled export of healthy foods, food safety irregularities, low nutrition literacy, and demotivation of frontline health and agriculture workers.

Conclusion: Efforts to transform the agriculture system must be accelerated. Supporting large-scale farming and scaling up initiatives of cluster and market-led farming, and lowland wheat production should be maintained. However, the initiatives need to mainstream production diversification as well. Building agricultural cooperatives' capacity, directly linking them with consumer cooperatives, and strengthening Consumer Protection Agency, are vital.

Keyword: Food Systems, Barrier and enabler analysis

Conflict of Interest Disclosure: The authors declare that they have no conflict of interest

PAB(T6)-218

"Smart meal" certification of employee canteens under the Healthy Meal and Food Environment Certification System for the promotion of Health and Productivity Management

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Background and objectives: The Healthy Meal and Food Environment (HMFE) Certification System that was launched in 2017 certifies restaurants and food service facilities that provide well-balanced meals (smart meals (SM)) and environments that are beneficial for employee health. In workplaces, certification is awarded as part of a Health and Productivity Management initiative. This study examined the SM certification status of employee cafeterias and clarified future challenges. Methods: Of the 386 offices that received SM certification (i.e., 5th certification) by 2021, consent to participate in this study was received from 361 (93.5%). The items considered included: number of meals during lunch (NM): number of SM provided (SM-P); certification status of optional items (OPTN), i.e., development of SM (D-SM) and promotion of a food environment (P-FE); and availability of registered dietitians (RD) and dietitians in the employee canteen. The SM provision rate (SM-PR) was calculated by dividing the SM-P by the NM. Results: The median NM in the analyzed facilities was 300 (25^{th} and 75^{th} percentiles: 125, 650) and the median SM-PR was 0.14 (0.07, 0.25). The percentage of canteens with an assigned RD was 47.6%, and no differences were observed according to the level of certification. However, the percentage of dietitians assigned in the first year (31.2%) increased to 50.0% by the fifth level of certification (chi-squared test, $p < 0.05$). Of 18 possible OPTNs, less than five were available at numerous facilities with level 1 and 2 certification, but more than five OPTNs were available at canteens with level 3 certification (2019; chi-squared test, $p < 0.05$). High mean OPTN percentages at canteens with level 5 certification were attributed to cereals (69.0%), nutritional information labels (energy, protein, fat, carbohydrates and salt equivalent) under D-SM (88.7%), reduced-salt seasoning (73.3%), not placing seasoning on tables (65.4%), and holding regular meetings as part of P-FE (70.7%). Conclusions: Office lunches are important tool for promoting employee health. However, relatively few offices are SM certified and the SM-PR is only about 10%. Future challenges to promoting employee health involve popularizing SM and increasing the quality of HMFE by increasing the percentage of optional items certified.

Keyword: Smart meal, the Healthy Meal and Food Environment Certification System, the Health and Productivity Management, employee canteens

PAB(T6)-219

An economic analysis of food consumption and implications for the transition to sustainable diets in Ireland

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Background and objectives: Food security and dietary cost has become a prominent focus of public health in recent years. Equity and nutrition security are considered central to a sustainable food systems transformation. However, research on dietary costs is limited, and an improved understanding of the economic impact of dietary changes has been identified as necessary to a transition to more sustainable diets. The objective of this analysis was to quantify the cost of diets reported in the Irish food consumption surveys and to investigate the relationship between dietary expenditure, food intake, demographic, and environmental factors. **Methods:** Diets reported in the National Adult Nutrition Survey (NANS; 2008–2010), National Teens Food Survey II (NTFSII; 2019–2020) and National Children's Food Survey II (NCFSII; 2017–2018) were analysed with under-reporters removed. A national food price database was compiled for 6,251 food codes and multiplied by consumed amounts. Diet quality was assessed using five diet quality indices and environmental impact was assessed using data on blue water use, GHGe, cropland, nitrogen, and phosphorous use. Multiple linear regressions, Spearmann correlations, ANOVAs with Bonferroni corrections and principal component analyses were used to evaluate dietary expenditure against additional factors. All analyses were completed using RStudio software (version 4.1.1). **Results:** Median daily expenditure was €4.07 (range €2.58 - €6.37) for children, €4.29 (range €2.65 - €7.34) for teenagers and €7.29 (range €3.57 - €21.18) for adults. Higher dietary expenditure was significantly associated with males across all population groups, a higher educational status and a more urban location in children and adults; higher social class in teenagers and; a higher BMI in children. Contribution of foods to dietary expenditure differed between population groups, however 'meat and alternatives'; 'eggs, dairy, and alternatives'; and 'starchy staples' constituted almost half of all dietary expenditure for all groups. Healthier and less sustainable diets were associated with a higher dietary cost. **Conclusions:** Dietary expenditure is relative to life stage, and influencing factors are inconsistent across population groups. Future interventions and policies should be socially inclusive by considering factors such as socio-economic status, and while healthier diets are more expensive, a transition to sustainable diets may reduce dietary cost.

Keyword: Sustainability, Food Consumption, Dietary Cost, Food Security, Sustainable Diets

Conflict of Interest Disclosure: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

PAB(T6)-220

Alkaline Water Improves Sleep Quality, Muscle Strength and Selected Metabolic Risks Among Postmenopausal Women in Malaysia

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Background and Objectives: Much have been claimed on the health benefits of alkaline water including metabolic syndrome (MetS) and its features with scarcity of scientific evidence. This cross-sectional comparative study was conducted to determine whether regular consumption of alkaline water confers health advantage on blood metabolites, anthropometric measures, sleep quality and muscle strength among postmenopausal women in Malaysia.

Methods: A total of 304 community-dwelling postmenopausal women were recruited with comparable proportion of regular drinkers of alkaline water and non-drinkers. Participants were ascertained on dietary intake, lifestyle factors, anthropometric and biochemical measurements. Multivariate analysis of covariance (MANCOVA) was performed to determine whether alkaline water consumption augments metabolic risks (fasting plasma glucose, systolic and diastolic blood pressures (BP), low density lipoprotein (LDL), triglycerides / HDL-C ratio), anthropometric measures (waist circumference, body weight), sleep duration and handgrip strength, with age and physical activity as the covariates of the model.

Results: A total of 47.7% of the participants met MetS criteria, with a significant lower proportion of MetS among the alkaline water drinkers. The observed lower fasting plasma glucose ($F(1,296) = 24.20$, $p=0.025$), triglyceride/HDL-C ratio ($F(1,296) = 21.06$, $p=0.023$), diastolic BP ($F(1,296) = 7.85$, $p=0.046$) and waist circumference ($F(1,296) = 9.261$, $p=0.038$) in the alkaline water drinkers could be considered as favourable outcomes of regular consumption of alkaline water. In addition, water alkalization improved duration of sleep ($F(1,296) = 32.07$, $p=0.007$) and handgrip strength $F(1,296) = 27.51$, $p=0.011$). Body weight ($F(1,296) = 27.51$, $p=0.011$), LDL-C ($F(1,296) = 1.772$, $p=0.287$), and systolic BP ($F(1,296) = 1.656$, $p=0.301$) were comparable between the two different water drinking behaviours.

Conclusion: Drinking adequate of water is paramount for public health with access to good quality drinking water remains a critical issue. While consumption of alkaline water may be considered as a source of easy-to implement lifestyle to modulate metabolic features, sleep duration and muscle strength, further studies are warranted for unravelling the precise mechanism of alkaline water consumption on the improvement and prevention of MetS and its individual features, muscle strength and sleep duration as well as identification of full spectrum of individuals that could benefit from its consumption.

Keyword: Alkaline water, metabolic risks, sleep quality, muscle strength, postmenopausal women

PAB(T6)-221

Development of a technical file to reduce, replace or eliminate trans fatty acids (TFA) in foods

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Background and objectives: The objective of this study is to determine the dietary sources of trans fatty acids in the Moroccan diet, with the aim of establishing a technical file to reduce, replace and eliminate *Trans* Fatty Acids (TFA) of industrial origin and to align with the World Health Organisation (WHO) recommendations. Knowing that mortality from Non-Communicable Diseases (NCDs) in Morocco is the main cause of death. It is estimated at 80% according to the WHO and premature mortality is estimated at 12%. Indeed, according to the national survey on the identification of risk factors for NCDs, among people aged 40 to 69 years, 4.9% had a cardiovascular risk ≧ 30%. This risk increased with age, it was 7.6% in people aged 55-69 compared to people aged 40-54 for whom this risk was estimated at 3.2%. Trans fatty acids contribute closely to this epidemiological picture because excessive consumption of TFA (intake greater than 2% of the TEA) is associated with an increase of 23%. % of cardiovascular risk. **Methods**: First of all, we wanted to determine the main dietary sources of trans fatty acids, these are, Edible oils (edible oil, frying oil, sunflower oil, partially hydrogenated palm and palm kernel oils) Shortenings, Margarines (pastry and spread), Chips, Cold cuts, Butter, Biscuits, Breakfast cereals, Yoghurts, creams and chocolate spreads. **Results**: The reduction and / or elimination of TFA requires the collaboration of three stakeholders, namely the government (represented by the Ministry of Health and the National Office for the Sanitary Safety of Food Products (ONSSA), by setting a limit for the content of TFA, making the mention of TFA obligatory on the labels and regulation the use of frying oils. The agro-industries food who can contribute by controlling oil production procedures. Finally, the consumers must be aware of TFAs risks and improve their food choices. **Conclusion**: This study will support the technical file that will be delivered to the authorities responsible to make regulations to reduce, replace and eliminate TFA.

Keyword: Trans fatty acids, reformulation, reduction, elimination

PAB(T6)-222

Combatting Iron Deficiency in Morocco : case of iron bioavailability of NaFeEDTA

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Background: As part of the fortification of staple foods. The NaFeEDTA complex is 2 to 3 times more bioavailable than ferrous sulfate and other fortifiers. It is known for its protective power of iron against various inhibitors such as phytates and polyphenols.

Objectives: Identification and evaluation of the bioavailability of iron from NaFeEDTA in anemic and non-anaemic women with or without consumption of green tea.

Methods: 46 childbearing age women were divided in 2 groups; non-anaemic group (NAG; n=25, age 18-41y) and anaemic group (AG; n=21, age 19-39y). Each group was used as self-control by using two different iron isotopes; 6mg of Fe57 (bread fortified with Na57FeEDTA) and 6mg Fe58 (bread fortified with NaFe58EDTA). Iron absorption was measured by the erythrocyte incorporation of isotopes after 14 days by ICP-MS analysis.

Results: The mean fractional absorption (MAF) of iron NaFeEDTA was 36.7% (range: 24.2-39.8) in AG and 16.7% (range: 9.2-24 ,2) in NAG ($p < 0.001$) from a test meal consumed with water and 4.1% (2.8-6.1) in AG and 1.4% (0 ,8-2,9) in NAG from a test meal consumed with tea. The mean inhibition was almost equal to 87.5% and 86.2% respectively in AG and NAG. The AFM was 2 times greater in case of iron deficiency anemia.

Conclusion: 18.88% of the 1.43 mg iron requirement per day would be covred with a test meal fortified with 6 mg of iron NaFeEDTA and consumed with tea in AG. The use of NaFeEDTA as a wheat flour fortifier can largely solve the problem of iron deficiency anemia in Morocco and a solid communication strategy which recommends the consumption of the tea one hour before or after the meal is still necessary.

Keyword: Bioavailability, Iron NaFeEDTA, Women of childbearing age, Anemia, Tea

Conflict of Interest Disclosure: NO CONFLICT OF INTEREST

PAB(T6)-223

Child nutritional intake in rural Cambodia: Application of Food Frequency Questionnaire and comparison with 24-h recall data

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Background and objectives: The nutritional status and nutrient intake of school-aged children in rural areas in Cambodia is largely unknown. This study aimed to assess the nutritional status and nutrient intake of school-aged children in rural Cambodia.

Methods: In February 2020, anthropometric measurements (height and weight), dietary surveys, and questionnaire surveys of household socioeconomic status were conducted, targeting 161 school-aged children in four rural communities in Stung Treng Province in Cambodia, in which forest is disappearing at the fastest rate in Southeast Asia. For the dietary survey, we applied the following two methods: 1) 56-item Food Frequency Questionnaire (FFQ) developed for use with Cambodian school children nationwide (including both urban and rural areas), and 2) 1-day 24-h dietary recall.

Results: The mean age of the children was 7.2 (± 1.0) years old, and 45.0% and 55.0% of the children were boys and girls, respectively. The prevalence rates of stunted and underweight children were 26.1% and 25.5%, respectively, which was higher than that reported in previous study in Cambodia. Overall, the energy and nutrient intake estimated by the two methods did not meet the recommended dietary allowance for Cambodian children. The energy and nutrient intake estimated by the FFQ was lower than the average intake reported in 24-h recall. The mean difference between FFQ and 24-h recall results ranged from 15.3% (carbohydrate) to 29.2% (energy and protein). Pearson's correlation coefficients for log-transformed energy and nutrient intake ranged from 0.157 (fat) to 0.367 (carbohydrate). Cross-classification analysis revealed that 36.0% (Ca) to 49.7% (carbohydrate) of participants were classified into the same tertile.

Conclusions: The energy and nutrient intake did not meet the recommended dietary allowance for Cambodian children, highlighting the necessity of nutrition improvement in the study area. The 56-item FFQ is moderately useful for correct classification of individuals in the population, although it underestimates the energy and nutrient intake.

Keyword: Cambodia, school-aged children, nutritional intake

PAB(T6)-224

Optimal vitamin D intake level for preventing serum 25–hydroxyvitamin D insuffciency in young Korean women

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Background and objectives: Vitamin D deficiency is prevalent but is particularly severe in young women. Vitamin D requirement is critical at a young age (18–25 years old) since peak bone mass is achieved at this stage. This study aimed to determine an optimal level of vitamin D intake for maintaining a healthy serum 25–hydroxyvitamin D(25(OH)D) level based on the season in young Korean women.

Methods: Based on the sunlight amount affecting serum 25(OH)D, December–April was designated as wintertime(WT) and June–October as summertime(ST). The recruited participants (WT, n=103; ST, n=117) underwent a lifestyle survey, 6-day dietary record, bone mineral density (BMD) test, and blood and urine tests. Multiple linear regression was performed to identify seasonal factors impacting serum 25(OH)D, and vitamin D intake for maintaining the 25(OH)D threshold was calculated using receiver operating characteristic curve analyses. The Chungnam National University Institutional Review Board approved this study.

Results: The serum 25(OH)D level was higher in the ST than that in the WT (15.2 ng/mL vs. 17.87 ng/mL, p<0.01). Intact parathyroid hormone level was lower in the ST than that in the WT (33.78 pg/mL vs. 43.54 pg/mL, p<0.001). However, no seasonal difference in BMD was noted. Serum 25(OH)D was influenced by vitamin D intake and income in WT and by vitamin D intake, UV exposure time, number of sunscreens and/or sunshade tools, and smoking in ST. Vitamin D intake was significantly associated with serum 25(OH)D, and a 1 µg/1000 kcal increase in intake increased the 25(OH)D levels by 0.155 ng/mL in WT and 0.072 ng/mL in ST (p<0.01). The vitamin D intake threshold for maintaining 25(OH)D levels at 20 ng/mL or higher was ≧ 10.97 μg/day.

Conclusions: The 2020 Dietary Reference Intakes for Koreans recommend a vitamin D intake of 10 µg/day for Korean adults aged 19–64 years. Vitamin D intake should be increased to maintain a serum 25(OH)D level of 20 ng/mL for bone health in young women.

Keyword: Vitamin D intake, 25-Hydroxyvitamin D, Bone mineral density, Ultraviolet ray exposure

Acknowledgment: This research was funded by the National Research Foundation of Korea Grant funded by the Korean government (Ministry of Science and ICT), grant number 2020R1A2C1009608 and WISET-2021-293.

PAB(T6)-225

A meal quality score based on Japanese healthy meal guidelines and its association with nutrient intakes in adult men and women

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Background and objectives: To promote health and prevent lifestyle-related diseases, the Ministry of Health, Labour, and Welfare of Japan has proposed standards for a healthy meal. This study aimed to develop a meal-based diet quality score based on adherence to the standards and examine associations of the score with nutrient intakes in adult Japanese men and women.

Methods: This cross-sectional study involved a secondary analysis of data from the 2017 Saitama Prefecture Nutrition Survey. We analyzed data obtained from a questionnaire and 2-day dietary records of 548 men and women aged 30–65 years with nutrient intakes within 0.5–99.5 percentile. The score for each meal (breakfast, lunch, and dinner), excluding eating out and alcoholic beverages, was calculated for six components based on the standard: grain dishes (amount of carbohydrate from grains), vegetable dishes (amount of vegetable, potato, mushroom, and seaweed intake), fish and meat dishes (amount of protein from seafood, meat, eggs, and soybeans), milk and dairy products, fruits, and salt equivalent. The scores for the first three components were adjusted based on the following sub-components: whole grain, green and yellow vegetable, red meat, and fish and soybean intakes. Each component was scored on a 10-point scale and 10 points were allotted if it met the criteria; otherwise, points were deducted and summed up to total scores (range 0–60 points) to examine associations with energy-adjusted nutrient intakes (per 650 kcal) for each meal using linear regression analysis controlled for age and sex.

Results: The median total scores were 26.1 (21.2, 32.1) points for breakfast (n=540), 24.8 (19.8, 28.6) for lunch (n=360), and 27.8 (23.6, 31.8) for dinner (n=507). Some nutrients, such as dietary fiber and vitamin A, were positively associated with the total score across all meals, but fewer were associated with dinner than with breakfast and lunch. However, the total score was positively associated with better macronutrient balance and lower salt intake at dinner.

Conclusions: The meal quality score developed in this study is efficacious for evaluating the quality of breakfast and lunch. However, further modification of the score is needed to evaluate the quality of dinner.

Keyword: meal quality, meal score, indices, dietary assessment, Japan

PAB(T6)-226

Double and triple-duty actions for addressing the global syndemic of obesity, undernutrition and climate change in childhood: a scoping review

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Background and objectives: Obesity, undernutrition, and climate change constitute a global syndemic that disproportionately affects vulnerable populations, including children. Actions that simultaneously address these pandemics are urgently needed to avoid further health, economic, and environmental consequences. Compiled evidence on double and triple-duty interventions (targeting two or the three pandemics simultaneously) is lacking. This review aimed to summarize data on the design, implementation and evaluation of whole-of-population interventions designed or adapted to be double or triple-duty and describe their effects on childhood.

Methods: Six academic databases were searched (January 2015 - March 2021) using terms related to 'children', 'interventions', 'nutrition', 'physical activity', and 'climate change'. Study protocols and peer-reviewed articles describing interventions designed or adapted to address any form of malnutrition and mitigate or adapt to climate change we included, as were those describing existing interventions that were assessed to see if they do no harm to other forms of malnutrition or the environment. Two independent reviewers conducted relevant article screening and data extraction.

Results: The search yielded 15,475 articles after duplicates were removed. Data were extracted from 43 studies, including 6 randomized controlled trials (RCTs). In total, we found 33 triple-duty, 8 double-duty, and 2 single-duty actions. Most studies described policies, programs or regulations, targeting the food system in the school setting. Evidence of community engagement was reported in 53% of studies. Out of the 43 interventions, 31 measured outcomes related to at least 2 components of the global syndemic. Dietary intake and food-related attitudes were the most common health-related outcomes while greenhouse gas emissions and food waste were the most measured climate change-related outcomes. Overall, 19 interventions (3 RCTs) showed positive double or triple-duty effects. Modelling studies indicate that strengthening the environmental sustainability of dietary guidelines is a cost-effective triple-duty action.

Conclusions: We found promising double and triple-duty actions for addressing the global syndemic in childhood. Highest quality studies point to food-related policies and programs that expose children to healthy and sustainable foods. Future research should ensure consistency in the type of outcomes measured to enable comparison with published studies and prioritise the evaluation of double and triple-duty effects.

Keyword: Triple-duty actions, Obesity, Undernutrition, Climate change, Childhood

PAB(T6)-227

Changes in dietary consciousness throughout the coronavirus infectious disease 2019 pandemic among Japanese adults

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Background and Objectives: The coronavirus infectious disease 2019 (COVID-19) has impacted the individuals' health concerns and behaviors. This study aimed to understand the changes in individuals' dietary concerns throughout the COVID-19 pandemic and examine the factors associated with these changes.

Methods: A web-based survey was conducted in July 2020 and September 2021. Participants were aged 20–69 years residing in 13 prefectures where COVID-19 regulations had been implemented in April 2020 and bought groceries and prepared meals ≧2 times a week. A total of 661 men and 678 women who completed both surveys were included the analysis. Dietary consciousness was measured using a validated questionnaire divided into two subscales; importance of diet (seven items) and precedence of diet (five items). Changes in dietary consciousness from 2020 to 2021 were categorized according to the median score of each subscale at each survey period: “low/low,” “low/high,” “high/low,” and “high/high.” Demographic and socioeconomic variables at baseline and follow-up were compared among four groups using chi-squared tests and residual analysis.

Results: The rates of participants in each category were 37.7%, 10.6%, 12.1%, and 39.6%, respectively, for the importance, and 6.4%, 38.8%, 31.3%, and 23.5%, respectively, for the precedence; therefore, changes in the precedence were observed in many participants. The participants who lowered the precedence of diet throughout (“low/high”) were more likely to be men, aged 30–39 years, unmarried, full-time workers, had household incomes of 4 to 6 million yen, and low subjective living status upon the survey and pre-pandemic. Conversely, those who raised the precedence of diet (“low/high”) were more likely to be women, aged 60–69 years, housewives, had household incomes of ≧6 million yen, and high subjective living status upon the survey and pre-pandemic.

Conclusions: Changes in the precedence of diet throughout were noted in approximately 70% of the participants, but only 20% have changed their importance of diet. The study reveals some demographic and socioeconomic characteristics related to the changes in dietary consciousness during the COVID-19 pandemic. It is important to consider the living conditions of the targeted population to develop a comprehensive approach for dietary behavior modification.

Keyword: vulnerable population, COVID-19, dietary habits, attitudes, Japanese

PAB(T6)-228

Attempts to prepare food for disasters with consideration for nutrition and water conservation.

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Background and objectives; It has been pointed out that, in the event of a disaster, the food supplied in shelters and other places is subject to nutritional over- or under-supply. In addition, it is assumed that this is done with limited resources. The aim of this research was to develop a menu for a soup kitchen that can solve these nutritional problems and is also practicable in terms of work and hygiene. **Methods;** 1) Based on the immediate target nutritional reference amounts (Ministry of Health, Labour and Welfare) for planning and evaluating the provision of meals in evacuation centres. 2) Dried foods (1 fruit, 3 mushrooms, 3 vegetables, 2 seaweeds and 1 bean) used in the prepared menus were returned for 50 people each, and the return rate and the amount of water required, etc. were investigated. The amount of water required, etc., was investigated. In addition, the study investigated whether using plastic bags to return dry goods would save water. **Results;** 1) In menus without raw meat, the amount of protein was very high (more than 80 g) because the B vitamins were supplemented with canned mackerel and fish sausages. When nutritionally adjusted foods were added to the menu, the vitamin B group could be met with less than 80 g of protein. 2) One to two staff were required for each task, including measuring, cutting, cooking and distributing the food. Aubergine chips, dried shiitake mushrooms and chopped kelp, which have a low water absorption rate in the 10% range, were found to have a high water saving rate of more than 60% when returned in plastic bags. All but the lowest-use dry goods could be returned in a bowl with an inner diameter of 36.0 cm. The use of plastic bags was possible with widths from 260 mm to 650 mm. **Conclusions;** It is clear that menus and processes that consider nutritional, hygienic and environmental aspects can be envisaged in advance during a disaster, and that the use of dried food can also lead to water savings, which could be used during cookouts.

Keyword: cookouts, shelters, dried food
Conflict of Interest Disclosure: None
Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-229

Effects of dairy beverages fortified with protein and micronutrients on the risk of early-stage undernutrition and frailty in community-dwelling older adults: A randomized, controlled trial

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Background and objectives: This study aimed to test the hypothesis that an intervention program that adds regular exercise and a dairy beverage fortified with protein and micronutrients further improves the risk of early-stage undernutrition and frailty in older adults.

Methods: A total of 74 community-dwelling older adults (mean age, 76.8 years) were randomly allocated to four groups; group A were supplemented with 400-kcal energy, 15-g dairy protein and micronutrients, group B with a 15-g dairy protein, group C with no supplementation but given nutritional education, and group D without any intervention (controls). Each group, except group D, performed the same resistance exercise program every other week for 28 weeks. Early-stage Undernutrition Score (EUNS), Mini Nutritional Assessment–Short Form, frailty (CL-15), mental health (WHO-5), Simplified Nutritional Appetite Questionnaire, weight, body mass index, fat-free mass index (FFMI), handgrip strength, and five-repetition chair stand test were measured before and after the intervention period. Two-way analysis of variance (ANOVA) was used to compare changes in all outcomes between groups, with sex and age treated as covariates. Similarly, a one-way ANOVA was used, with sex and age as covariates, for changes within groups. The Friedman test was used for multiple comparisons.

Results: Groups A and B showed decreased EUNS (changes over time: −0.95 ± 0.35 and −0.45 ± 0.36, respectively), but group D showed increased CL-15 score (0.45±0.29). Group A gained weight and showed increased muscle mass (FFMI: 0.32±0.10 kg/m^2), increased handgrip strength (1.11±0.39 kg), and improved WHO-5 (0.76±0.75), although they showed a decreased appetite compared to the other groups. Group B had improved muscle mass (FFMI: 0.17±0.10 kg/m^2) and handgrip strength (0.53±0.40 kg) and decreased five-repetition chair stand time (−0.57±0.36 s), although their body weight decreased. However, no significant group-by-time interactions were found in any outcomes.

Conclusions: The intervention groups showed a trend toward improved risks of early-stage undernutrition and frailty compared to the control group. Dairy protein supplementation during resistance exercise increased muscle mass and improved physical performance in older adults. These changes were greater in the group with energy and micronutrients supplimentation in addition to milk protein.

Keyword: lder adults, dairy protein, micronutrients, energy, muscle mass

PAB(T6)-230

Relationship between Weight Gain and Stress Factors among Working-age People in Yugawara Town, Kanagawa Prefecture, Japan: A Cross-sectional Study.

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Background and objectives. The aim of study was to determine the sociodemographic and lifestyle factors associated with weight gain among working-age people living in Yugawara town, Japan.

Methods. A cross-sectional study was carried out among Japanese citizens aged 19-64 years, living in Yugawara town in Kanagawa prefecture, Japan. Data were collected between February and March 2015 through a household survey exploring sociodemographic characteristics and lifestyle patterns of the participants. For statistical analysis of the study data, mean (SD) values were determined and a bi-variate logistic regression model was performed to determine the factors associated with overweight status. The level of statistical significance was set at $p < 0.05$.

Results. In total, there were 796 participants; based on their answers on weight and height on the survey sheet, body mass index (BMI) was calculated. Then, participants were stratified into three subgroups as follows: “underweight” for participants with a BMI < 18.5 kg/m^2, “normal weight” for those with a BMI between 18.5-24.9 kg/m^2, and “overweight” for those with a BMI > 25.0 kg/m^2. There were 137 (17.2%) overweight and 659 (82.8%) participants with either normal weightor low BMI. “Overweight status” was positively associated with "being unable to manage stress" (OR: 1.66; 95% CI: 1.10-2.51; p=0.015), "stress relief by eating" (OR: 1.63; 95% CI: 1.03- 2.57; p=0.036),"stress relief by watching TV" (OR: 1.70; 95% CI: 1.09-2.66; p=0.020) ,"feeling unhealthy" (OR: 1.95; 95% CI: 1.16-3.25; p=0.011) , "eating dinner alone" (OR: 1.58; 95% CI: 1.03- 2.44; p=0.038), "lower frequency of drinking alcohol" (OR: 2.16; 95%CI: 1.41-3.32; p<0.001).

Conclusions. Findings from this study suggest that weight gain is influenced by stress factors in a sample of working-age Japanese people living in Yugawara town, suggesting the importance of good stress management approach to prevent obesity and related health problems.

Keyword: weight gain, risk factor, questionnaire survey, stress relief, logistic regression

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-231

Intervention strategies and effectiveness of health-related interventions to reduce obesity and unemployment in adults.

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Background and objectives: Obesity and unemployment are interconnected, complex social and health issues with devastating effects on mortality, health, wellbeing and quality of life. While there is clear research evidence on the interrelations between unemployment and obesity, there is lack of holistic approaches to addressing unemployment and obesity using common strategies. The objective of this study was to conduct a systematic realist synthesis to investigate the interrelation between unemployment and obesity and understand the effectiveness of health-related interventions designed to reduce overweight, obesity and unemployment.

Methods: Systematic literature searches were conducted in 6 electronic databases including Cochrane library, Medline, SocIndex, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scopus, and PsychInfo. Studies were screened using predefined exclusion criteria followed by subsequent data extraction from included studies. Extracted data was coded for Context-Outcome-Mechanism configurations (CMOcs). Data synthesis and analysis was conducted using a realist approach to thematic analysis to identify common intervention strategies, outcomes and effectiveness and to refine the final program theory. Results are presented using a narrative synthesis.

Results: A total of 83 out of 11495 studies screened met the inclusion criteria and assessment for relevance and rigour and were included in the final data synthesis. Seven common strategies were identified to be highly effective in both health-related unemployment and obesity interventions. These included knowledge and skill building to enable behaviour change, increasing motivation, cognitive behaviour therapy/positive psychology, improving self-efficacy, confidence and self-esteem, building resilience and emotional competency, hands-on practice of behaviour, knowledge and skill building on goal-setting, identification of barriers to achieving goals, and self-monitoring. Multicomponent interventions, combining more than two strategies and tailored to participants' unique circumstances were more effective and resulted in positive outcomes.

Conclusions: This study provides the first realist evidence on complex health-related interventions and novel insights into holistic approaches to address unemployment and obesity. The findings contribute to an emerging field in systematic review and highlights overlooked perspectives which should be considered in future research.

Keyword: Obesity, Overweight, Unemployment, Health-related intervention, Realist synthesis

Conflict of Interest Disclosure: None declared

PAB(T6)-232

Daily fruit and vegetable consumption habits during COVID-19 pandemic: A cross-sectional study

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Background and objectives: Although the effects of COVID-19 are still not fully understood, its relationship with the immune system is outstanding. A healthy diet is an integral part of the immune system. Adequate consumption of fruits and vegetables boosts immunity due to their vitamin and antioxidant content. Therefore, we aimed to investigate daily fruit and vegetable consumption habits during COVID-19 pandemic.

Methods: This study was conducted as an online survey between June and December 2021. Inclusion criteria were as follows: (1) being 18 to 65 years old, (2) using social media, and (3) being able to understand Turkish. Besides socio-demographic characteristics and COVID-19 status of participants, study questionnaire involved a food frequency questionnaire aimed to assess fruit and vegetable consumption. In addition, participants' beliefs regarding the efficacy of fruits and vegetables on COVID-19 were investigated.

Results: A total of 1767 individuals participated in this cross-sectional study. Most of the respondents were women (76.9%). The mean age was 29.07±11.50 years. Daily fruit consumption was reported by 37.7% of the participants and they consumed 1.99±0.69 portions a day. Daily vegetable consumption was reported by 30.1% of the participants and they consumed 2.17±0.82 portions a day. There was no difference in fruit and vegetable consumption habits between COVID-19 (+) and COVID-19 (-) participants (fruits: 40.7%, 2.05±0.7 portions/day and 36.8%, 1.97±0.68 portions/day, vegetables: 32.7%, 2.20±0.75 portions/day and 29.3%, 2.15±0.85 portions/day respectively). However, when the participants were asked whether they consumed adequate amounts of fruits and vegetables, 50.4% claimed adequate fruit consumption and 36% claimed adequate vegetable consumption. COVID-19 (+) participants claimed a higher consumption ratio compared to COVID (-) participants. Overall, 76.9% of participants believed that fruits and vegetables have a role in treatment and protection against COVID-19.

Conclusions: This study demonstrated that most of the participants did not consume adequate amounts of fruits and vegetables.

Keyword: COVID-19, fruits, vegetables, immunity

PAB(T6)-233

Overweight and social marginalization among preadolescent children in Taiwan

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Background: Weight-related stigma may exert adverse effects on psychosocial health of children and adolescents, yet possible underlying mechanisms have been less delineated. The present study aims to examine the extent to which overweight status was associated with peer relations and network positions among preadolescent children.

Methods: Data were obtained from a 2017 cross-sectional survey conducted in Taiwan's Keelung City, with the study population comprising the fourth graders (9-11 years old) in 42 public schools (n= 2,333, response rate= 97.3%). Body mass index (BMI) was ascertained by self-reported weight and height. Children's school-wide social networks and status (i.e., marginalization and isolation) were assessed by child's peer nomination (maximal five). Linear and generalized mixed-effect models were applied to examine the risk of having few nominations and being isolated by weight status.

Results: Overweight children were found to have fewer indegree nominations (4.07 ± 2.83 vs. 3.00 ± 2.42, p<0.0001) and reciprocal ties (1.93 ± 1.45 vs. 1.43 ± 1.31, p<0.0001) as compared with their non-overweight peers. After adjustment for socioeconomic characteristics, participation in school activities, school-level network features (network size, density), and school average BMI, overweight preadolescents received 1.10 fewer nominations (p<0.0001) and were more likely to have 0 indegree nomination (OR: 1.75, 95% confidence intervals [CI]: 1.28-2.39). Overweight may elevate the risk of having a marginal or isolated position in the school-based social network by 71% (95% CI: 1.38-2.12). Gender-stratified analysis indicated that overweight-related increased risk of social isolation was more prominent in girls (OR: 2.63, 95% CI: 1.85-3.74) than in boys (OR: 1.34, 95% CI: 1.01-1.77).

Conclusion: Overweight in preadolescence appeared associated with having fewer friends and being marginalized/isolated in school, especially girls. Targeted efforts are needed to ameliorate weight-based social marginalization/isolation and to avoid spiral-down effects throughout adolescence.

Keyword: Body mass index, social marginalization, social network analysis, network position, peer relation

PAB(T6)-234

Prevalence and determinants of Hypertension and Diabetes among different Indian populations groups: Findings of the National Nutrition Monitoring Bureau surveys

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Background and Objectives: Non-communicable diseases (NCDs) are leading causes of mortality globally and are collectively responsible for almost 70% of all deaths and the causes could be due to combination of genetic, physiological, environmental and behavioural factors. The objective of the current communication is to determine the strength of association between overweight/obesity, diet, demographic factors and hypertension & diabetes among tribal, rural and urban populations in India as available data accessed from the large epidemiological diet and nutrition survey carried out by the National Nutritional Monitoring Bureau.

Methods: The NNMB repeat surveys were carried out periodically every decade in 120 randomly selected villages each state, from 10 major states in India among tribal (2008-09), rural (2011-12) and urban (2015-16) population by adopting multistage stratified sampling procedure.

Results: A total of 70,525, 56,425, and 1,23,175 adults 18years and above were participated from tribal, rural and urban areas, respectively, for the survey. The prevalence of overweight and obesity (34-44%), hypertension (24-25%) and diabetes (19-22%) was significantly high among urban population as compared to the rural (10-14%, 23-25%, 7-8%%) and tribal (3-4%, 22-23%) population, respectively. Regression analysis showed that general, abdominal and central obesity, diet, age, gender are important risk factors for hypertension & diabetes among all the population groups. A principal component analysis revealed that the predominant contribution for obesity was unhealthy diet and ultra processed food consumption.

Conclusions A multi-component extensive health and nutrition education intervention program is the need of the hour to control the epidemic increase of all non-communicable diseases in the low and middle income countries like India.

Keyword: Diet, Diabetes, Hypertension, Non-communicable diseases, Obesity

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: No collaborators

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-235
Feasibility testing of Food-Based Dietary Guidelines recommendations in Ghana

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Background and Objecitives: Ghana is developing its first food-based dietary guidelines. The proposed technical recommendations that have been developed were field tested to determine comprehension and feasibility among male and female adults.

Methods: Seventy-two focus group discussions were held in x communities across the three main ecological zones of Ghana between February and March of 2022. Participants were adults (18 years+) or adolescents (12-17 years) selected to be representative of rural- and urban communities in Ghana. For each ecological zone, discussion guides were pretested and used to guide 12 group discussions involving between eight and twelve participants. The questions were intended to determine respondent understanding and comprehension of the technical recommendations, willingness to adopt the recommendations, anticipated barriers to adoption, and implications of adoption. In addition 12 focus groups were held in each ecological zone to test feasibility of images designed to facilitate communication of the recommendations. These focus groups asked questions to determine clarity and legibility of the images and their suitability in communicating the associated recommendation.

Results: Generally, the recommendations were comprehensible to participants in the discussion groups across all ecological zones. Because many of the respondents were not literate, comprehension of the recommendations was only possible if the messages (originally constructed in English) were translated into local languages. There was also high interest and willingness to adopt the recommendations. However, in some communities, there was recognition that the adopting the recommendations will increase the cost of diets. This was especially linked to the cost of fruits and vegetables. The images were generally recognizable regarding the messages intended. However, the images were fully comprehensible when they were accompanied with explanation.

Conclusions: The technical recommendations for Ghana's Food-based Dietary Guidelines and the accompanying images are generally well understood and require only minor edits based on feedback from focus group participants.

Keyword: recommendations, Food-based, guidelines, comprehension, feasibility

Conflict of Interest Disclosure: None to declare

PAB(T6)-236
Associations of gender with BMI and dietary intakes in a cohort of children in Northern Ireland

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Background and objectives: Childhood obesity is a major public health concern in the UK, affecting both males and females. A combination of lifestyle, dietary and environmental factors contribute to the aetiology. The aim of this study was to investigate whether differences exist between boys and girls in Northern Ireland (NI) for dietary intake and anthropometry in children.

Methods: Participants were offspring of healthy pregnant mothers recruited within the third trimester as part of the Belfast cohort of the Hyperglycaemia Adverse Pregnancy Outcome (HAPO) study, a prospective observational study examining maternal glycaemia and pregnancy outcomes. Participants (n=706) attended one follow-up visit between 2011-2016 (~12 year follow up) for metabolic investigations where dietary, anthropometry and lifestyle data were collected. 3-day semi-quantitative dietary intake at the study visit was analysed using Nutritics Nutritional Analysis Software (v5.74 RE) to provide quantitative nutrient data. Level of deprivation was categorised from postcodes. BMI z-scores were calculated to categorise children as underweight (<-2SDs), normal weight (>-2-0.99SDs), overweight (>1-<2SDs) or obese (>+2SDs) (WHO, 2007).

Results: Participants were mean age 12.0 years (range 10.1-13.8, SD 0.862) with 49.6% boys (n=348) and 50.4% girls (n=353). More girls were classified as overweight/ obese (35%) than boys (23%). Mean energy intake (EI) was higher for boys (7429kJ) than girls (6669kJ). Those with a higher BMI (boys and girls) were found to self-report lower EI (p=0.005), with two thirds of under-reporters overweight/ obese. No difference in % EI from protein, carbohydrate or fat between BMI categories was observed for boys or girls when including or excluding mis-reporters. Children from more deprived areas had a higher BMI (p=0.003). Boys had higher fibre intakes (mean 16g/d) than girls (mean 14g/d) (p<0.001).

Conclusions: More girls were overweight and obese than boys, however, overall EI of girls did not differ from boys although increased levels of mis-reporting of EI was observed at higher BMIs. Differences were observed between children's deprivation level and BMI. No differences were noted between BMI and dietary intakes. Further studies are required to explain gender differences in BMI observed in children to assist in developing targeted interventions aimed at reducing obesity risk.

Keyword: children, obesity, BMI

PAB(T6)-237

Adopting a Gender Transformative Approach to Increase Participation in Income Generating Activities and Dietary Diversity of Women of Reproductive Age: Evidence from Suchana -a Multi-Sector Initiative in Bangladesh

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1. Helen Keller International (Bangladesh)

Background and objectives: Helen Keller Intl's gender transformative approach (GTA), the Nurturing Connections (NC)© curriculum, was streamlined into a six-year multi-sector initiative, Suchana, that aims to prevent child undernutrition of the poor and very poor in the first 1,000 days of their lives in the Sylhet Division of Bangladesh. The GTA curriculum was integrated into the technical trainings for agriculture, nutrition, and market development to challenge gendered barriers related to agriculture, health, and nutrition behaviors. This study explores the association between women's participation in critical household decisions and their own dietary diversity and participation in income. **Method:** We use a recent primary dataset of present participant households from Suchana. Data were collected using a seasonal cross-sectional cluster random survey in each season of food production. This study analyzes data from Suchana's first implementation phase (2017-2018) during which four rounds of data were collected from November 2017 to December 2018 from 300 villages for a total of 1,487 respondents. Adjusted logistic regression analysis was conducted to examine the relationship between women's participation in critical household decisions and dietary diversity scores. **Results:** During the implementation period being examined, the proportion of women consuming an inadequate diet (fewer than 5 of 10 food groups) reduced (31%-27%) with increased participation in all critical household decisions including own income, own healthcare, child healthcare, major household purchases, daily food purchases, food preparation, and visiting family (27%-32%). Adjusted logistic models reveal that the average dietary diversity score of women associated with greater odds of participation in all critical household decisions (AOR .754, CI 0.66,0.86, p<0.00). Controlling other household level variables, women's age (AOR 1.07, CI 1.03,1.10, p<0.00), selling vegetables (AOR 1.07, CI 1.003,1.14, p<0.038), selling poultry birds (AOR 1.79, CI 1.06,3.03, p<0.029), and support in-laws in homestead gardening (AOR 1.2 CI 0.52,2.77, p<0.009) was also associated with participation in household decisions. **Conclusion:** Women's participation in critical household decisions positively impacts women's dietary diversity and participation in income generating activities. Integrating GTA, across technical implementation areas can be an effective way to addressing gender inequality and support household members to work together for better nutrition outcomes for women.

Keyword: Gender Transformative Approach, Dietary Diversity, Decision Making

Conflict of Interest Disclosure: None

Further Collaborators: none

PAB(T6)-238

Association between recommended Japanese dietary patterns and the source of salt intake among middle-aged Japanese adults: Analysis of food grouping based on NOVA system

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Background and objectives: The government food and nutrition policy and guidelines in Japan recommend meals comprising staple, main, and side dishes (SMS meals). No study has examined the relationship between consumption of SMS meals and the source of salt intake. Therefore, we aimed to evaluate the association between consumption of SMS meals and the source of salt intake among middle-aged Japanese adults based on the degree of food processing (NOVA system).

Methods: A cross-sectional study was conducted using data of 153 men and 195 women from the Saitama Prefecture Health and Nutrition Survey 2011. Dietary intake was assessed using 2-day dietary records. We calculated consumption of SMS meals based on the serving data from Japanese Food Guide Spinning Top: the number of servings per dish was calculated per plate, and the number of servings per dish per meal was summed every breakfast, lunch, dinner, and between meals. We calculated the total number of servings per day. Finally, we calculated the average of 2 days. The frequency of SMS meals was classified into <1,≧1 and <2,≧2. Food items were classified according to the NOVA system into the following four groups: unprocessed or minimally processed foods (UMPF), processed culinary ingredients (PCI), processed foods (PF), and ultra-processed foods (UPF). Analysis of covariance adjusted for age, family structure, income, and total energy and was used to analyze the association between consumption of SMS and the source of salt intake.

Results: The proportion of single men was significantly the highest among subjects who consumed SMS meals at least once a day. In men and women, salt intake (%) from PCI, such as soya sauce and miso was significantly higher as the consumption of SMS increased. However, salt intake (%) from UPF, such as store-bought rice ball, sweets, fatty or salty snacks was significantly higher as the frequency of SMS decreased.

Conclusions: Salt intake from PCI was high among participants who consumed SMS meals more than twice a day, whereas salt intake from UPF was high among those who consumed SMS meals less than twice a day. Thus, the salt reduction countermeasure should be modified considering the consumption of SMS.

Keyword: salt intake, NOVA system, middle-aged adults, Japanese

Further Collaborators: Saitama prefecture

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-239
Associations between types and sources of dietary carbohydrates and liver fat: a UK Biobank study

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Background and objectives: Excessive liver fat can lead to non-alcoholic fatty liver disease (NAFLD). Evidence on the associations between dietary carbohydrates and liver fat remains unclear. This study aimed to examine the associations between types and sources of dietary carbohydrates and liver fat.

Methods: The study included UK Biobank participants with no pre-existing diabetes, liver disease or cardiovascular disease. Dietary intake of types and sources of carbohydrates (total carbohydrates, total sugars, free sugars, non-free sugars, total starch, starch from whole grains, starch from refined grains, and fibre) was measured using at least two 24-hour dietary assessments. In a cross-sectional analysis (n=27,272), the Hepatic Steatosis Index (HSI) was calculated at baseline (2006-2010). A score of 36 or higher defined cases of 'high liver fat'. Odds ratios (OR) of high liver fat by quintiles of carbohydrate intakes were estimated using multivariable logistic regression models. In a prospective analysis, a second sample (n=3,915) had liver proton density fat fraction (LPDFF) measured by magnetic resonance imaging (2014-2020). Multivariable linear regression models estimated geometric means of LPDFF (%) by quintiles of carbohydrate intakes. All models were adjusted for confounders, including total energy intake.

Results: In cross-sectional analyses, 8,823 cases of high liver fat were identified. Inverse associations between intakes of fibre (OR of highest vs. lowest quintile 0.47 [95% CI: 0.44-0.51]), non-free sugars (0.66 [0.62-0.70]) and starch from whole grains (0.53 [0.50-0.58]), with liver fat were observed. Positive associations between starch from refined grains and liver fat were observed (1.25 [1.18-1.32]). Free sugars showed no significant associations with liver fat. In prospective analyses, inverse associations with LPDFF (%) were observed for intakes of fibre (-0.74 geometric mean difference between highest and lowest quintile of intake [-0.85 to -0.62]), non-free sugars (-0.73 [-0.67 to -0. 78]) and starch from whole grains (-0.53 [-0.49 to -0. 58]). Free sugars and starch from refined grains were positively associated with LPDFF (0.33 [0.30 to 0.36]) and (0.31 [0.17 to 0.46]), respectively.

Conclusion: This study suggests that different carbohydrate types and sources, as opposed to overall carbohydrates, have varying associations with liver fat, which may be important for NAFLD prevention.

Keyword: NAFLD, hepatic steatosis, sugar consumption, dietary carbohydrates, dietary fibre

Conflict of Interest Disclosure: None

PAB(T6)-240
Degree of food processing and risk of head and neck and oesophageal cancers in the European Prospective Investigation into Cancer study

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Background and objectives: Evidence suggests that food processing may be associated with cancer risk. Associations between different degrees of food processing and head and neck cancer (HNC) and oesophageal cancer (OC) have not been fully explored. We aimed to investigate these associations in the European Prospective Investigation into Cancer (EPIC) cohort.

Methods: EPIC recruited 521,323 adult participants across 10 European countries between 1992 and 1998. Our study included 450,111 EPIC participants, of which 814 and 409 were incident cases of HNC and OC, respectively. Food frequency questionnaires were used to obtain dietary data at baseline and the NOVA classification was used to categorise foods into four groups according to their degree of processing. We used Cox proportional hazard models to investigate associations between the consumption of unprocessed/minimally processed foods (NOVA 1), processed foods (NOVA 3) and ultra-processed foods (NOVA 4) and the risk of HNC and OC.

Results: A 10% increase in the proportion of grams of ultra-processed food in the diet was associated with an increase in the risk of HNC (HR=1.16, 95%CI 1.07–1.27, events=814) and oesophageal adenocarcinoma (HR=1.25, 95%CI 1.06–1.48, events=215). Among HNC subtypes, a strong positive association was found for pharynx cancer (HR=1.25, 95%CI 1.09–1.44, events=264) and larynx cancer (HR=1.20, 95%CI 1.04–1.38, events=310), but not for oral cancer (HR=0.97, 95%CI 0.81–1.15, events=277). Similarly, a 10% increase in the proportion of processed food was associated with a higher risk of HNC (HR=1.26, 95%CI 1.19–1.34; pharynx cancer HR=1.23, 95%CI 1.10–1.37; larynx cancer HR=1.23, 95%CI 1.12–1.35; oral cancer HR=1.30, 95%CI 1.17–1.45) and oesophageal squamous cell carcinoma (SCC) (HR=1.77, 95%CI 1.58–1.98, events=194). In contrast, a 10% increase in the proportion of unprocessed/minimally processed food was associated with a lower risk of HNC (HR=0.73, 95%CI 0.69–0.78; pharynx cancer HR=0.77, 95%CI 0.70–0.85; larynx cancer HR=0.77, 95%CI 0.71–0.85; oral cancer HR=0.82, 95%CI 0.74–0.91) and oesophageal SCC (HR=0.66, 95%CI 0.59–0.74).

Conclusions: Reducing the intake of processed and ultra-processed foods in favour of unprocessed/minimally processed foods may confer protection against HNC and OC. Further research is required to uncover the mechanisms underlying our findings.

Keyword: Nutritional epidemiology, Food processing, NOVA classification, Oesophageal cancer, Head and neck cancer

Further Collaborators: Corinne Casagrande (International Agency for Research on Cancer), Kiara Chang (Imperial College

London), Fernanda Rauber (University of São Paulo), Renata Bertazzi Levy (University of São Paulo), Eszter Vamos (Imperial College London), Antonio Agudo (Catalan Institute of Oncology), Paul Brennan (International Agency for Research on Cancer), Carolina Borges (University of Bristol), Rebecca Richmond (University of Bristol), Tom Richardson (University of Bristol and Novo Nordisk), George Davey Smith (University of Bristol), on behalf of the EPIC Network

PAB(T6)-241

The effect of important food sources of fructose-containing sugars on adiposity: a systematic review and meta-analysis of controlled feeding trials

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Background and Objective: The effect of various food sources of sugars, other than sugar-sweetened beverages (SSBs) providing excess energy, on weight gain is unclear. We conducted a systematic review and meta-analysis of controlled trials on the effect of different food sources of fructose-containing sugars on body weight and markers of adiposity at different levels of energy control.

Methods: MEDLINE, Embase, and the Cochrane Library were searched through April 2022 for controlled trials ≧2-weeks. Four trial designs were prespecified by energy control: substitution (energy matched replacement of sugars); addition (excess energy from sugars added to diets); subtraction (energy from sugars subtracted from diets); and ad libitum (energy from sugars freely replaced). The primary outcome was body weight. Secondary outcomes included other markers of global and abdominal adiposity. Independent reviewers extracted data and assessed risk of bias. GRADE assessed certainty of evidence.

Results: We identified 169 controlled trials (255 trial comparisons, N=10,357) assessing 14 food sources at 4 levels of energy control. Total fructose-containing sugars increased body weight and BMI in addition trials; decreased body weight, waist circumference and waist-to-hip ratio in subtraction trials; and had no effect in substitution or ad libitum trials. There was evidence of interaction/influence by food source: substitution trials (fruit decreased and added nutritive sweeteners and mixed sources (with SSBs) increased outcomes); addition trials (dried fruit, honey, and 100% fruit juice (≦10%E) decreased and SSBs, fruit drink, 100% fruit juice (>10%E) and mixed sources (with SSBs) increased outcomes); subtraction trials (removal of mixed sources (with SSBs) decreased outcomes); and ad libitum trials (mixed sources (with SSBs or without SSBs) increased outcomes). The certainty of evidence was moderate to low for most comparisons.

Conclusions: Energy control and food source appear to mediate the effect of fructose-containing sugars on adiposity. The evidence provides a good indication that excess energy intake from SSBs, other sugary beverages, and mixed sources (with SSBs) increase adiposity, whereas removal of energy from mixed sources (with SSBs) decrease adiposity. Most other food sources have no effect with some sources (fruit, 100% fruit juice (≦10%E), dried fruit, honey) showing decreases irrespective of energy control.

Keyword: adiposity, body weight, food sources, systematic review, meta-analysis

Clinicaltrials.gov: (NCT02558920)

Conflict of Interest Disclosure: LC was a Mitacs-Elevate post-doctoral fellow jointly funded by the Government of Canada and the Canadian Sugar Institute (Feb 2019-Aug 2021).

AC received funding from a Toronto 3D MSc Scholarship award. AA received funding from a Toronto 3D MSc Scholarship Award and a Canada Graduate Student-Master's Award from the Canadian Institutes of Health Research.

SA-C has received funding from CIHR Canadian Graduate Scholarship-Master's, the Loblaw Food as Medicine Award, and the Ontario Graduate Scholarship.

TAK has received research support from the Canadian Institutes of Health Research (CIHR), the International Life Science Institute (ILSI), and National Honey Board.

FA-Y is a part-time Research Assistant at INQUIS Clinical Research, Ltd., a contract research organization.

DL received a stipend from University of Toronto Department of Nutritional Sciences Graduate Student Fellowship, University of Toronto Fellowship in Nutritional Sciences, University of Toronto Supervisor's Research Grant - Early Researcher Awards, and Dairy Farmers of Canada Graduate Student Fellowships; a scholarship from St. Michael's Hospital Research Training Centre, and a University of Toronto School of Graduate Studies Conference Grant.

JLS has received funding support, honoraria, consulting, and/or travel fees from a broad range of food, beverage, and ingredient companies, trade associations, government agencies, health charities, private foundations, and/or other commercial or non-profit entities with an interest in sugars and chronic disease prevention and management. For a complete list of disclosures, please see https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2790045

Further Collaborators: Vanessa Ha 1,2,3, Nema McGlynn 1,2, Sonia Blanco Mejia 1,2, Andreea Zurbau 1,2,4, Vivian L Choo 1,2, Russell J de Souza 1,2,5,6, Thomas MS Wolever 1,2,4, Lawrence A Leiter 1,2, Cyril WC Kendall 1,2,7, David JA Jenkins 1,2

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PAB(T6)-242

Designing interventions to address factors impacting maize flour fortification compliance among small and medium scale millers in Kenya

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Background and objective: Large-scale food fortification is one of the strategies adopted by the Government of Kenya to address high prevalence of micronutrient deficiencies. Kenya has mandatory fortification of packaged maize and wheat flour, edible oils and salt. However, maize flour fortification compliance to regulatory standards remains low (28%), due to poor technical and financial capacity of small, medium-scale millers. Nutrition International (NI) supports government and millers in increasing production and availability of adequately fortified maize flour. In 2020 and 2021, NI conducted two rounds of rapid appraisal of millers to determine factors impacting compliance to fortification standards and design targeted capacity-development interventions.

Methodology: Rapid appraisals included: (i) quantitative data collection; (ii) observation of fortification processes; (iii) iron spot test (IST) of flour samples. In the 2020 round, 18 out of 20 millers who NI was supporting were selected using a predetermined criterion: (i) mills operational at the time of assessment; (ii) voluntary participation; (iii) consent to conduct IST. In 2021, NI expanded the program to cover more millers across six millers' associations. 62 of 280 millers (22%) were selected mainly using the same criteria, in addition to including those had received NI's support. A total of 56 flour samples were tested for compliance.

Results: High maize grain prices (by 38% in 2020, 28.2% in 2021) and aflatoxin levels (by 19.1% in 2020, 34% in 2021) were reported as major challenges. In 2020, COVID 19 had a significant effect on millers' business performance; millers reported operating at less than half of their installed capacity. In 2020, 35% mills reported shortage of premix due to COVID-19 restrictions, in 2021, high costs and poor quality were premix-related challenges reported by 27.4% and 15.1% respectively. While majority (>90%) owned microdosers, weekly calibration of microdosers was done by <30% mills.

Conclusion: It is important to identify issues that impact fortification compliance and design specific capacity-development/ intervention packages for millers to improve QA/QC procedures, technology and adherence to standards. NI-supported implementation of interventions contributed to improvement in compliance of production of adequately fortified maize flour from 28% in 2020 to 39% in 2021.

Keyword: Maize flour fortification, Micronutrient deficiencies, Maize millers, Compliance to regulatory standards, Capacity development

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-243

Impact of urbanization on food systems and nutrition leading to metabolic syndrome in Low- and Middle-Income Countries: A systematic review and Meta-analysis

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Background and objectives: The prevalence of metabolic syndrome (MetS) is on the rise in an urbanizing world. Urbanization is likely associated with the reduced access to healthy food patterns. An understanding of health effect of this process is needed for effective interventions and policies. The study objective is to review the impact of urbanization on food systems and nutrition leading to the development of MetS in Low- and Middle- Income Countries (LMIC).

Methods: A comprehensive search of five databases (PubMed, Web of Science, Scopus, Embase and Cochrane Library) was performed from November 2021 to January 2022. Following to the Preferred Reporting Items for Systematic Reviews and Meta- Analysis (PRISMA) guidelines, peer-reviewed studies conducted from 1954 to January 2022 and published in English were included in the present systematic review. Appropriate search terms were used for the main concepts which are MetS, dietary patterns and urbanization in LMIC. Study selection was done in two stages an in duplicate.

Results: 34 studies out of 8,875 identified studies met the eligibility criteria. The rate of MetS varied from 11.0% to 57.8% depending on sex, age and region. The highest rate (57.8%) was observed among the Egyptian urban residents in Alexandria. The lowest rate (11.0%) was reported in northwest Chinese adults. A difference in prevalence of MetS between urban and rural resident was found in the majority of studies. Fifteen studies reported a significant association between dietary patterns and the prevalence of MetS. Similarly, seventeen studies showed a significant association between urbanization and MetS.

Conclusions: This systematic review identified possible association between low access to healthy food and the high prevalence of MetS in urban residents.

Keyword: Urbanization, Food systems, Nutrition, Non-communicable diseases, Metabolic syndrome

Conflict of Interest Disclosure: None

PAB(T6)-244

Food Consumption Data Collection in the Balkan Region According to the EFSA EU Menu Methodology Standards and its further applications in project FNS-Cloud

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Background and Objective: Initiatives in the Capacity Development in Nutrition Research in the Balkan region in the last decade have focused on developing Research Infrastructure (RI) compliant with European standards to overcome the evident lack of comparable and harmonized food consumption and food composition data in the region. This study presents a process implementation of the European Food Safety Authority (EFSA) EU Menu methodology during the EFSA support projects for Food consumption data collection in four countries (Serbia, Montenegro, Bosnia and Herzegovina, and North Macedonia) in a synchronized way. The study also explores how the data is employed on an open-access pan-European platform like the H2020 project called FNS-Cloud.

Methods: The EU Menu methodology in Balkan countries was made possible by applying an innovative tool for standardized food consumption data collection and dietary intake assessment, the DIET ASSESS & PLAN (DAP). DAP operates with the Balkan food platform (Serbian food composition database (FCDB) and Regional FCDB), compliant with European Food Information Resource (EuroFIR™) standards. It includes computerized food consumption, anthropometric measurements, physical activity questionnaires, a validated food picture book, and a FoodEx2 exposure hierarchy with sets of facet descriptors of the interest. FoodEx2 and LanguaL coding systems enable flexibility in data utilization and facilitate the food matching process and international data comparability. To enable harmonized data collection, methodology required the development of study protocol, extensive education and training of study personnel, and process surveillance by internal and external coordinators.

Results: Food consumption data from the Balkan region are cataloged and matched with their datasets from Europe within EC H2020 project FNS-Cloud, creating a platform for interconnected food databases and research tools for various research in food composition and consumption, nutrition, and other related topics.

Conclusions: The collection of food consumption and composition data in the Balkan region presents evidence for further nutrition research, provides infrastructure for policy-making lacking in public health nutrition in the region, and has a long-term effect on developing a sustainable food system. Harmonization with European standards categorizes these datasets as adequate for joining the international research arena for further exploitation.

Keyword: Balkan region Research Infrastructure, nutrition research, food composition and consumption, EU Menu Harmonized methodology, H2020 FNS-Cloud

PAB(T6)-245

Association between chewing habit and risk of excess gestational weight gain

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Objective: Achieving appropriate gestational weight gain (GWG) during pregnancy is essential for maternal and child health. It has been reported that those who chew more often have a lower risk of obesity, but few studies have examined GWG during pregnancy and mastication. Therefore, this study aimed to clarify the relationship between mastication habits and the risk of excess gestational weight gain among Japanese women.

Methods: This study analyzed data from a prospective cohort study conducted from May 2010 to November 2013 at National Center for Child Health and Development, a hospital in an urban area (Tokyo, Japan), which included 1246 pregnant women. Participants fulfilled a questionnaire about dietary habits during 26–40 weeks' gestation. We categorized participants into three groups based on responses to the question "Do you chew your food well?": Group 1, "never" or "rarely"; Group 2, "sometimes"; and Group 3, "usually" or "always". We assessed GWG using the Optimal Weight Gain Chart for Pregnancy from the Japanese Ministry of Health, Labor and Welfare; participants' weight gain was classified as "excess" if it exceeded the criteria. We performed multivariate logistic regression analysis to examine the relationship between the risk of excess GWG and chewing habits.

Results: Of the 1246 participants, 137, 434, and 675 were classified into Group 1, Group 2, and Group 3, respectively. While there were no significant differences in age, pre-pregnancy BMI, or energy intake among the three groups, a significant difference in gestational weight gain (Group 1: 10.5 kg ± 3.8, Group 2: 10.1 kg ± 3.7, Group 3: 9.5 kg ± 3.5, p = 0.004) was found. The current study found pregnant women in Group 3 had a higher risk of excessive GWG compared with those in Group 1 (OR: 0.512, 95%CI: 0.348–0.755), albeit non-significant difference between Group 1 and Group 2.

Conclusions: Pregnant women who regularly chew their food well had a lower risk of excess GWG.

Keyword: Pregnancy, Gestational weight gain, Dietary habit

PAB(T6)-246

Greenhouse Gas Emission from Food Consumption; Results from the Icelandic National Dietary Survey 2019-2021

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Background and objectives: Food is one of the main drivers of global greenhouse gas emission. It is important to investigate the environmental impact of food choices in relation to health. The dietary carbon footprint (DCF) based on results from the National Dietary Survey have not been examined for Iceland before. The objective was to estimate the DCF of dietary habits of Icelandic adults. This was done by using three independent food databases from different countries, due to a lack of local data for the carbon footprint of food consumed in Iceland.

Methods: A carbon footprint calculator was implemented, using data from three different food databases from Denmark, the US, and France, which all include the carbon footprint of the presented food items. The DCF was calculated using results from the latest National Dietary Survey, including data from 2019-2021. This was a random study sample of 18-80 years old Icelanders including 822 participants, 428 (52%) females and 394 (48%) males. The participation rate in the National Dietary Study was 51%. In addition to background data, two non-consecutive 24-hour recalls of food intake, and a food frequency questionnaire were used to evaluate dietary intake.

Results: Total DCF from the three databases was on average 7.4 kg $CO_{2\ eq}$. The highest DCF emission originated from the consumption of meat and meat products (39%) (median 800g/week) and dairy products (16%) (median 250g/d), while DCF emission from the consumption of seafood (median 300g/week) had a wider range (6-17%). Beverages also contributed to a significant portion (13%), while other food groups contributed less than 10% to the DCF in all the databases.

Conclusion: The main driver for the DCF of Icelandic food consumption, as identified by the three databases, was considerable meat and dairy consumption, contributing to an average of 55% of the total DCF. The consistent results obtained suggest that uncertainties in estimating DCF from different foods using the three databases are not critical in terms of identifying key drivers of greenhouse gas (GHG) emissions.

Keyword: National Dietary Surveys, Dietary Carbon Footprint, Sustainable Diets, Environmental Impact, Food Composition Databases

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: None

PAB(T6)-247

The estimated health impact of the World Health Organization global sodium benchmarks for packaged foods in Australia: a modelling study

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Background and objectives: In 2021, the World Health Organization (WHO) set global sodium benchmarks for 58 packaged food categories, to help countries put in place feasible and effective sodium reformulation programs for lowering sodium intake and preventing related diseases. We modelled the potential dietary and health impact of achieving the WHO's global sodium benchmarks in Australia and compared it to the potential impact of the Australian government's 2020 sodium reformulation targets.

Methods: We used nationally representative data on food and sodium intake, sodium levels in packaged foods, and food product sales volume to estimate sodium intake pre- and post-implementation of the WHO sodium benchmarks and the Australia's current sodium reformulation targets, for 24 age-sex groups (>24 years). Using data from the Global Burden of Disease Study and comparative risk assessment models, we estimated the potential deaths, incidence, and disability-adjusted life years (DALYs) averted from cardiovascular disease (CVD), chronic kidney disease (CKD) and stomach cancer based on the reductions in sodium intake.

Results: Full compliance with the WHO's global sodium benchmarks for packaged foods in Australia could lower average adult sodium intake by 404mg/day, corresponding to a 12% reduction. This could prevent about 1,770 deaths/year (95% uncertainty interval 1,168 to 2,587), corresponding to 3% of all CVD, CKD and stomach cancer deaths in Australia, and prevent some 6,900 (4,603 to 9,513) new cases, and 25,700 (17,655 to 35,796) DALYs/year from CVD, CKD and stomach cancer. Full compliance to the Australian government's current sodium reformulation targets was estimated to reduce sodium intake by 3% (or 107mg/d) and avert around 510 deaths/year (335 to 757). By adopting WHO's sodium targets for packaged foods instead of Australia's targets, this could avert around 1260 *more* deaths (95% UI 740 to 1,950) each year.

Conclusion: Achieving the WHO global sodium benchmarks for packaged foods in Australia could avert around 1,770 deaths/year – more than triple the number of deaths that could be averted through Australia's current sodium reformulation program. The Australian government could strengthen its current reformulation program to have substantially more health impact by adopting WHO's more strict and comprehensive sodium targets for packaged foods.

Keyword: salt, nutrition, hypertension, food policy, public health nutrition

PAB(T6)-248

Comparison of eating behaviors, self-rated health and food intake of college students pre- and post-COVID-19

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Background and objectives: The coronavirus disease 2019 (COVID-19) pandemic has had several impacts on human lives. In 2020, Japan underwent measures close to lockdown for several months. In 2021, life was gradually returning to normal but eating out, including alcohol drinking, remained restricted in Japan. Many other things, including increased stress and lack of exercise, have been reported. In this study, we examined the presence or absence of lifestyle changes, self-rated health (SRH) status and eating habits of pre- and post-COVID-19 Japanese university students.

Methods: A cross-sectional survey was conducted among Japanese adolescents in 2019 and in 2021. The self-administered SRH and food frequency questionnaires distributed to the students contained 18 items. The change variables were analyzed using t-test and Fisher's exact test. P<0.05 was considered statistically significant.

Results: The participants (n=193) were mostly female (75.1%), aged at 20.0±0.9 y.o. and had a self-reported BMI of 21.3±3.6 kg/m^2. Regarding eating behaviors, the proportion of participants “shopping for dinner”, “helping with meals”, “have conversation during meals” and “concerned about food” was higher in 2021 than in 2019 (P<0.05). Regarding food intake frequency, the vegetable intake of the participants was higher in 2021 than in 2019 (86±89 (2019) vs 194±119 (2021) g/day, P<0.05). Intake of the nutrients β-carotene (2309±1302 vs 2864±1525 µg/day), vitamin K (171±83 vs 209±90 µg/day), vitamin C (58±28 vs 97±35 mg/day) and dietary fiber (9.8±3.3 vs 11.4±4.1 g/day) was higher in 2021 than in 2019 (P<0.05). There were no significant differences in SRH between 2019 and 2021.

Conclusions: Comparing the participants in 2021 and in 2019, their eating behaviors improved and vegetable intake increased. The increased may be due to restriction on eating out. Nutrients derived from vegetable were also increased. Thus, in these 2 years, eating behaviors changed, but SRH did not change.

Keyword: COVID-19, Self-rated health, University students

PAB(T6)-249

Associations of carbohydrate quantity and quality with all-cause and cause-specific mortality in a prospective cohort study

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Background and objectives: The long-term effects of low carbohydrate diets on health outcomes are controversial and inconclusive. We aimed to examine the associations of carbohydrate quantity and quality with mortality from all-cause, cancer, and cardiovascular disease (CVD) mortality among Korean adults.

Methods: We included 113,043 participants aged 40-69 years who did not report extreme caloric intake after excluding those who died within three years from the baseline in the Health Examinees-Gem (HEXA-G) study in Korea. Participants' dietary intake was recorded using a validated semi-quantitative food frequency questionnaire. We used Cox proportional hazards regression model to calculate hazard ratios (HRs) and 95% confidence intervals (CIs) for all-cause, cancer, and CVD mortality.

Results: During an average follow-up of 9.2 years, a total of 2,009 deaths (1,035 deaths from cancer and 304 deaths from CVD) were documented. After multivariable adjustment, <55% of energy intake from carbohydrates was significantly associated with increased risks of all-cause and CVD mortality compared to 55-65% of energy intake from carbohydrates when total fat was replaced with carbohydrate; HRs (95% CIs) were 1.43 (1.02-2.02) for all-cause mortality and 3.41 (1.53-7.63) for CVD mortality. However, we did not find any association with cancer mortality [HR (95% CI) = 1.08 (0.65-1.79) for <55% vs. 55-65% of energy from carbohydrates]. When we examined the association of dietary glycemic index (GI) and glycemic load (GL) with mortality, we did not find significant associations.

Conclusions: The data from the HEXA-G study indicated that <55% energy intake from carbohydrates was associated with an increased risk of mortality from all-cause and CVD among populations with high carbohydrate intake.

Keyword: Carbohydrate intake, Carbohydrate quality, Mortality, Cohort study

Conflict of Interest Disclosure: The authors declare no conflicts of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-250

Research on the actual nutritional status and the development of nutritional tools for older adults participating in Kayoinoba

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Background Japan urgently required policies for managing an expected increase in the number of older adults in need of long-term care in the near future. Current approaches have included the expansion of Kayoinoba (community-based salon for the older adults) that can contribute to prevention of disability and dependency. With regard to nutrition, Kayoinoba activities such as shared meals are expected to address undernutrition; nevertheless, evidence of specific outcomes is limited. Therefore, this study aimed to examine physical and nutritional status among older adults participating in Kayoinoba and create a nutritional support tool based on results that can be utilized in this setting.

Methods The current study included 651 adults who participated in a Kayoinoba that provided meals. The survey items included nutritional status assessment using the Mini Nutritional Assessment - Short Form (MNA®-SF); an oral examination; grip strength and anthropometric measurements; and body composition measurement using In Body S10. We also administered a self-assessment questionnaire including a basic frailty assessment checklist. We described health characteristics of Kayoinoba participants. Then, we developed support tool consisting of the specific contents of basic frailty assessment checklist. The predictive validity of this tool was determined by calculating sensitivity and specificity.

Results Based on MNA®-SF, participants' nutritional status was categorized into risk of malnutrition (22.1%), and malnourished (1.7%). The prevalence rate of frailty based on basic checklist was 22.4%. Developed tool has 4 questions regarding nutrition and oral health. The cut-off to best differentiate between individuals with risk of malnutrition and malnourished was 1 with a sensitivity of 72% and specificity of 51%. The screening score based on only the question of nutrition has lesser predictive validity.

Discussion and conclusion the percentage of Kayoinoba participants with undernutrition was small, many were at risk; the frailty rate was about double that of in previous studies. This suggests a need for measures that enable the early discovery of undernutrition and frailty at Kayoinoba. Based on these results, we created a simple nutritional support tool that can be used in Kayoinoba. We plan to disseminate and teach people about the tool for use in the future.

Keyword: older adults, undernutrition, oral function, community-based salon, nutritional support tool

Conflict of Interest Disclosure: The authors have no financial conflicts of interest to disclose concerning the presentation.

PAB(T6)-251

Food Environmental Interventions Using Nudge Tactics in a Hospital Convenience Store is Cost-Effective

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Background and objectives: During the COVID-19 pandemic, protecting healthcare workers' wellbeing has become even more essential than before. A food environment intervention was conducted in a hospital convenience store in Tokyo to improve employees' eating habits. The objectives of this study were to evaluate increased store sales and the cost-benefit of the intervention.

Methods: This strategy incorporated nudge tactics, a behavioural economics technique that entails increasing healthy options as well as easy-to-pick-up placement, eye-catching information and price incentives. Sales were examined by means of a quasi-experimental design. The control store was of the same company inside another hospital in Tokyo. The results were compared for five months, i.e. from April to August 2019. The primary outcome of this strategy was an improvement in overall sales, whereas the sub-outcomes entailed increased sales of the targeted products and an increased number of bowl noodles sold by salt content. All sales were evaluated using a sample *t*-test, whereas the number of bowl noodles sold was evaluated using the Mann–Whitney *U* test. The costs and benefits were analysed for one year, i.e. from April 2019 to March 2020. Costs were defined as the increased expenses required for the intervention, including point-of-purchase advertising production costs, decreases in revenue due to price discount, the costs of implementation specialists and others. Benefits were defined as increases in total sales. The evaluation indices used were the cost-benefit ratio and net benefits.

Results: At the intervention store, total sales relative to average sales for the same period of the previous year increased by 106% ($p < 0.001$); furthermore, targeted product sales for salads, sugar-free beverages and others increased between 120% and 146%. Number of bowl noodles sold decreased significantly for high-salt items ($p < 0.001$). The control store showed no such changes. The total cost of the intervention was ¥1,188,388, and the profit earned was ¥3,001,436. Therefore, the cost-benefit ratio and net benefit were 2.5 and ¥1,813,048, respectively.

Conclusions: The results indicate that this food environmental intervention in the hospital's convenience store by means of nudge tactics was cost-beneficial and contributed to increasing the store's sales.

Keyword: food environment, intervention study, cost-benefit analysis , nudge, convenience store

Conflict of Interest Disclosure: TERUKO KAWABATA is an employee, MASAKAZU NAKAMURA is a board member and TAKASHI YAMADA is an executive vice-president of Japan Association for Development of Community Medicine which runs both intervention and control hospitals and was the franchise

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

owner-operator of both intervention and control convenient stores at the period of this study.

of food systems are bolstered by household production of nutritious plant and animal-based foods.

Keyword: Food Security, COVID-19, Homestead Food Production

Conflict of Interest Disclosure: None

Further Collaborators: none

PAB(T6)-252

Can an Enhanced Homestead Food Production (EHFP) Program Improve a Household's Resilience to the COVID-19 Pandemic: Evidence from Rural Bangladesh

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Background and objectives: This study investigates the impact of an Enhanced Homestead Food Production (EHFP) approach (to produce plant and animal-based foods at home for consumption and income generation) on household food consumption, women's dietary diversity, and household food security following shutdowns due to the COVID-19 pandemic in Bangladesh. To examine a potential causal link, we use a recent primary dataset of former and present participant households of a six-year, multi-sector initiative in Sylhet Division, SUCHANA, that aims to prevent child undernutrition of the poor and very poor in the first 1,000 days of their lives.

Methods: Data were collected using a seasonal cross-sectional cluster random survey in June-July 2020 using a structured questionnaire from 1,464 participant households randomly selected from four project implementation phases that took place between 2017-2020. Households were divided into former (six months since exited), active (18-30 months since starting the program), and newly enrolled (not started EHFP) households. To measure the impact of EHFP in terms of exposure duration, we compared the newly enrolled households with former and active households. Level of production, consumption from HFP, household food security, and women's dietary diversity were assessed and compared.

Results: Former and active households significantly ($p<0.00$) produced more vegetables (43% and 79%, respectively), eggs (79% and 150%), and poultry (71% and 90%) compared to newly enrolled households. Severe food insecurity was 4% and 7% less prevalent among former and active households compared to the newly enrolled group. Former and active households were 15% and 1.5% respectively less likely to have suffered from food scarcity or decreased food consumption compared to newly enrolled households. Minimum dietary diversity was higher for women in the former (11%) and active (21%) groups compared to the newly enrolled group.

Conclusions: From 1999 to 2016, Bangladesh has developed national policies that identify HFP as a pathway to resilience and poverty reduction, in part by involving women in agriculture. Our research suggests that rural poor households' ability to cope with the protracted crises, the associated restrictions, and disruption

PAB(T6)-253

Effects of the COVID-19 pandemic on the diet of Chilean elderly people.

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Background and objectives: Chile is experiencing an advanced demographic transition characterized by an increase in life expectancy accompanied by an accelerated population aging. The COVID-19 pandemic placed a burden on the health system, the economy, and people's quality of life. Older people are one of the groups that has been most affected due to this situation, among other things they have difficulties to carry out their activities of daily living. Our research objective is to characterize the food access of Chilean elderly people during the Covid-19 pandemic and its association with different factors.

Methods: A cross-sectional study was carried out in a sample of older adults from two regions of Chile (Central and South of the country), a questionnaire was applied via telephone to assess the impact of the pandemic on their daily lives. We used chi squared test to compare differences in the consumption of multiple groups of foods between sexes. we carry out logistic models adjusted for sex, age, region of origin and depression, to evaluate the association of the difficulty of access to food in the context of a pandemic.

Results: The total sample is 374 participants, 59.4% from the central zone, 73% are women, the average age is 74.2$\pm$7.6 years. In relation about having difficulty accessing the purchase of food, 15.5% declares having some or many problems, when observing differences between the sexes, statistically significant differences can be observed 21.8% in men vs 13.2% in women $p<0.05$. When we asked about the consumption of fruits and vegetables, 11.3% of the participants declared to have decreased their consumption due to social isolation, without differences according to sex. In the logistics models we found significant associations between sex (Women) (OR:0.43 CI95%:0.21-0.88), Region (South) (OR:59 CI95%:13.16-264.76) and depression assessed by GDS-5 (OR:2.44 IC95%:1.12-5.32) with the access to fruits and vegetables.

Conclusions: The social isolation caused by the pandemic has affected the diet of the elderly, making it difficult to access healthy foods such as fruits and vegetables and this could impact their nutritional and general health status.

Keyword: Aging, Diet, COVID-19

PAB(T6)-254

Barriers and enablers towards achieving effective coverage of key nutrition interventions in LMICs

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Background and objectives: Nutrition related factors contribute to 45% of under five deaths. Successful scale up of evidence-based nutrition interventions remains challenging. To inform future strategies, the Asset Tracker project sought to identify and understand barriers and enablers to scale across key nutrition interventions: IFA (iron-folic acid), MMS (multiple micronutrient supplementation), EIBF/EBF (early initiation and exclusive breastfeeding), FSSN (feeding of the small and sick newborn), BEP (balanced energy protein), and MgmtAM (management of acute malnutrition).

Methods: The Asset Tracker 6-stage scale-up framework toward effective coverage—global guidelines and market availability, national policy adoption, system integration and readiness, implementation and service delivery, availability, and coverage—anchored data collection, analysis, and synthesis across a multistep approach for each intervention. This included a literature review on barriers, enablers, and implementation; 41 global and 53 country key informant interviews across five countries (Burkina Faso, Ethiopia, India, Kenya, and Nigeria); compiling 99 nutrition indicators relevant to our six assets from DHS, SPA, SARA, HMIS, ENAP, and WHO Policy Survey; and reviewing 277 policy documents, budgets, guidelines, and training curriculums. Tableau data visualizations were created to aid interpretation and presentation as an interactive Global Good.

Results: The six interventions were categorized into three subgroups relating to barriers, enablers, and implementation reach along the framework towards effective coverage. Subgroup 1 (new and donor-dependent) for BEP, MMS, and FSSN; subgroup 2 (complex and for specific cases) for MgmtAM; and subgroup 3 (available/supported by not equitable) for IFA and EIBF/EBF. All six assets had a global policy available, only three (IFA, EIBF/EBF, MgmtAM) had a national policy in the five countries. Two of six assets (IFA, EIBF/EBF) reached the last data milestone representing effective coverage. IFA:5-50% of pregnant women took >90 IFA tablets. EIBF/EBF:42-73% of infants were put to the breast within the first hour of life; 29-61% of children <6 months are EBF in priority countries.

Conclusion: Data availability is lacking for most assets to complete the scale-up story. Gaps across the implementation framework prevent effective coverage. Tailored strategies by subgroup could be utilized to address implementation barriers along the framework and accelerate uptake, implementation, and effective coverage.

Keyword: Breastfeeding, supplementation, undernutrition, barriers, scale

Funder: Bill & Melinda Gates Foundation

Conflict of Interest Disclosure: Conflict of Interest: Nothing to disclose.

Further Collaborators: Danielle Hume (PATH USA), Monica Kothari (PATH USA), Arja Huestis (PATH USA)

PAB(T6)-255

The effects of the active education combined with weekly taking iron supplements to increase the nutritional status and anemia of the reproductive Tay ethnic women in Vietnam

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Background and objectives: Anemia is a common disease among reproductive Vietnamese women, especial in minor ethnics. This study aims to evaluate the effect of positive communication in raising awareness combined with weekly taking iron tablets on the nutritional status and anemia among Tay ethnic reproductive women.

Methods: A non-randomized quasi-experimental, controlled before-after study was conducted in two wards in Phu Luong District, Thai Nguyen Province, in 2017-2018. The participants were 188 Tay ethnic women aged 20-35 years. They had no hematologic diseases or pregnant. All participants were divided into the intervention group (n=96) and the control group (n=92). Both groups were performed the anthropology and blood testing at the enrollment and the end of study. The intervention group were given as following interventions: health workers'home visits to access their nutrition condition to provide consultations about anemia; joining an outstanding communicator competition in anemia in reproductive women; taking an iron supplement Fumafer-B9 Corbiere 200mg (66mg iron+1mg folic acid) every Sunday for 6 months. Healthcare workers monthly monitored by meeting the intervention group. The control group did not receive medicine, monitoring, or consultations. Chronic energy deficiency (CED) was defined as BMI<18.5kg/m^2. Anemia was defined as hemoglobin (Hb)<12.0g/dL and ferritin<15µg/L. The data were analyzed by STATA13.0, one-sample T-Test and paired-sample T-test were used.

Results: The study outcomes were evaluated after 6 months. The CED proportion in the intervention group decreased to 13.6%, compared with 3.3% of the control group. Hb and serum ferritin increased by 5g/l and 19.2g/l, respectively in the invention group. The control group showed no change in the Hb level and an increase of 1.7mg/L of the serum ferritin level. Regarding the proportion of anemia, the intervention group showed a decreased to 15.6%, the control group increased to 1.1%. The iron storage depletion reduced by 10.4% in the women

using medicine, and 2.2% in the control group. The statistical analysis was significant difference.

Conclusions: Intervention by positive communication combined with taking iron tablets weekly has improved nutrition and anemia situation in the 20-35 aged women of Tay ethnic.

Keyword: Stunting, Community, Nutrition, Behaviours

PAB(T6)-256
Galvanizing Community Actions and Male involvement to address Stunting in Shefa and Sanma Provinces in Vanuatu.

Leiwaku Noah, Adaeze Oramalu-Ogwuche, Jennifer Weiss, Carolyn O'Donnell, Anne Crawford, Adele Harmer

Background and objectives: Globally, chronic malnutrition, which is evident by stunting, has declined steadily since 2000 – but faster progress is needed to reach the 2030 Social Development Goals target. According to the 2021 Global Nutrition Report, stunting rates in Vanuatu increased from 25.7% to 28.9% between 2008 and 2013 and the prevalence of anemia among women of reproductive age increased from 24% in 2010 to 25% in 2016. Various factors affect nutrition practices and behaviour change such as traditional norms, influence of fathers & older women in the household. Save the Children (SC) implemented the ***First 1,000 Days Program*** in 22 selected Communities in Shefa and Sanma Provinces of Vanuatu from 2017 to 2021 with the aim of contributing to the reduction of stunting in Children under 2 by increasing coverage of evidence-based health and nutrition practices among pregnant and lactating women (PLW) and caregivers.

Methods: **SC used the Community Action Planning (CAP)** approach to establish Development Committees, develop community-led solutions, and strengthen community engagement for the adoption of appropriate MCHN behaviours. This approach resulted in stronger engagement of Men for the promotion and prioritization of maternal and child health and nutrition (MCHN) behaviours. SC used the ***Peer Support Group Approach*** to deliver preventive nutrition interventions directly to beneficiaries including promotion of maternal and child health and nutrition (MCHN) practices among PLW, older women in the households and men.

Results: Endline evaluation among beneficiaries showed stunting rates reduced from 20.8% to 13.8%, minimum acceptable diet increased from 35.7% to 54.2%. Also, knowledge of key MNCH practices increased significantly among women (84.9%) and men (81.8%), increase consumptions of grains/roots, dairy, flesh foods and vitamin A-rich fruits & vegetables for children 6-23 months and women of reproductive age. Women who reported they could make decision for their own and child's health and nutrition increased to 40% while 77% of men agree that decisions on the health and nutrition of mother and child should be jointly made.

Conclusions: Effective engagement of men in programme implementation creates conducive environment for the adoption of appropriate health and nutrition behaviours in the household.

Keyword: Stunting, Community, Nutrition, Behaviours
Conflict of Interest Disclosure: None

PAB(T6)-257
Using co-design to change attitudes towards food waste and healthy eating in adolescents

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Background and objectives: One-third of food produced globally is lost or wasted, having severe impacts on greenhouse gases. One major cause of food waste at the consumer level is leftovers, which are often seen as unappealing and are often thrown out. Adolescents are a key age group to target with behaviour change interventions as they are developing their life-long beliefs and behaviours. The aim of this intervention was to increase awareness of food waste and healthy eating, build adolescents' capacity for preparing and cooking food.

Methods: An 8-week co-design intervention (Re-licious) was piloted in a secondary school during Food Technology classes. Students watched videos on food waste and healthy eating based on information from the dietary guidelines. Students worked in small groups to identify leftover ingredients at home, and repurposed them to create a delicious meal suited to their needs. Students co-created criteria focussing on the question 'what is important to you in a recipe?' to ensure relevancy of recipes. Pre-and post-intervention questionnaires about food skills, food waste attitudes, and motivation and interest in health and healthy eating.

Results: 40 students aged 13 (n=16) or 14 years old (n=24) participated. Factors identified in the co-creation activity were: time taken to cook, difficulty level, healthiness e.g. inclusion of fruit or vegetables, and sustainability of ingredients. There was an increase in intention to reduce food waste ($p=0.007$), resourcefulness i.e. creating recipes with limited ingredients ($p<0.001$), and a change in personal norms, with students more likely to feel guilty when wasting food post-intervention ($p=0.048$). Re-licious reduced the number of students with low motivation and interest in health and healthy eating (n=6 to n=1) and increased those with high interest (n=11 to n=23).

Conclusions: Re-licious was successful in changing students' attitudes towards food waste and increasing students' motivation and interest in health and healthy eating. Re-licious holds promise in promoting sustainable lifestyles and should be scaled up in different age groups and populations.

Keyword: social marketing, behaviour change, food waste, healthy eating

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-258

Determinants of Receiving Anti-helminth Medication Among School-Age Children during National Deworming Week in the Chittagong Hill Tracts of Bangladesh

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Background and Objectives: Soil-transmitted helminth (STH) infections are common chronic infections resulting in lower levels of key micronutrient adequacy, including vitamin A, iron, copper, selenium, cobalt, and zinc. To address this challenge, Helen Keller Intl, in collaboration with the Bangladesh Ministry of Health & Family Welfare, and with funding support from Johnson & Johnson, initiated a project to control STH in Bandarban District of the Chittagong Hill Tracts of Bangladesh. We explore the determinants of receiving anti-helminth medication among school-age children during the National Deworming Week (NDW). **Methods:** Data were obtained from a repeated cross-sectional post-coverage survey, one month after distribution of preventive chemotherapy during NDW in October 2018 from 1159 randomly selected households in 168 villages across the sub-district of Bandarban Sadar. Our analysis includes 1705 children aged 5 to 16 years. We undertook multivariate logistic regression analysis to better understand the characteristics associated with the receipt of medication. **Results:** During the NDW, 87% of school-aged children received deworming tablets. Multivariate logistic regression indicates older children (AOR 1.08, 95% CI 1.02-1.15, p<0.01), school-going children (AOR 31.58, 95% CI 18.48-52.92, p<0.00, and parents with a greater knowledge score on helminth infections (AOR 1.25, 95% CI 1.12-1.41, p<0.00) have a positive correlation with receiving medication. Distance of households from primary and secondary schools was not significantly related to receipt of medication. Controlling these factors, the education level of the household heads was not positively correlated with the receipt of anti-helminth medication. **Conclusions:** This study shows that parents' knowledge on helminth infections may be one of the key drivers that motivate children to receive medication, regardless of the education level of household heads. Awareness-raising campaigns on this topic should be reinforced.

Keyword: Anti-helminth Medication , Nutrition, Determinants, School-Age Children , Chittagong Hill Tracts

Conflict of Interest Disclosure: None Declared

PAB(T6)-259

Effect of underweight and anaemia in pregnancy on birthweight among rural pregnant women in Tamil Nadu

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Background and objective: Low birthweight (LBW) is the leading cause of neonatal deaths and poor growth in children in India. Poor maternal malnutrition before and during pregnancy is an important risk factor for adverse pregnancy outcomes. Aim of this study is to estimate the combined effects of anaemia and underweight in rural pregnant women on the risk of delivering LBW infant in two sites of Tamil Nadu state in South India from Household Air Pollution Intervention Network (HAPIN) study **Methods:** 779 women with singleton pregnancies who were eligible and consented to participate were recruited <20 weeks of gestation with ultrasound confirmation. Maternal weight, height, haemoglobin and sociodemographic characteristics were obtained at baseline (BL). Birth weights were obtained within 24 hours of delivery (n=773 livebirths). Women were classified based on their Body Mass Index (BMI) and haemoglobin (Hb) levels at BL into 4 groups: G1-only underweight (BMI<18.5kg/m^2), G2-only anaemic (Hb<11g/dl), G3-anaemic & underweight and G4-neither anaemic nor underweight. Binomial logistic regression analyses were performed to assess the combined effect of anaemia and underweight on LBW (<2500gm) after adjusting for age, height, education, wealth index, gestational age (GA) at BL, parity, birth spacing, household food insecurity, dietary diversity, change of fuel use in pregnancy. **Results**: Mean maternal age, height, BMI, Hb and GA at BL were 23.9±4y, 151±1.4cm, 19.8±3.2kg/m^2, 10.4±1.3g/dl and 16±3 weeks, respectively. The mean GA at birth was 38.9±1.5 w. Mean birthweight of infants was 2591±393g. The prevalence of LBW was 49.5%, 29.6%, 50.9% and 36.8% in G1(n=91), G2(n=307), G3(n=212) and G4(n=163), respectively; 53.8% of new-borns were male. Compared to women in G4, the crude odds ratio (OR) for having LBW babies in G1, G2 and G3 were 1.6(95% CI 0.9-2.7:p=0.10), 0.7(0.5-1.1;p=0.11) and 1.8(1.2-2.7;p=0.007). The adjusted ORs for G1, G2 and G3 were 1.6(0.9-2.7;p=0.1), 0.7(0.4-1.0;p=0.05) and 1.7(1.1-2.7;p=0.015), respectively. **Conclusions:** BL underweight in women was the major contributor to LBW. The co-existence of anemia and underweight at BL was linked with significantly increased risks of LBW. Better outcomes in only anemic group may be due to the timing of Hb measurement, and possible prospective corrective measures taken during pregnancy course.

Keyword: Pregnant women, Low BMI, Anaemia, Low birth weight, India

Conflict of Interest Disclosure: None

Further Collaborators: HAPIN Investigators

PAB(T6)-260

ssociation between Dietary Patterns, Anthropometric status, Lifestyle, and Bone Mineral Density among Postmenopausal women in Taiwan: A Cross-sectional Study

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Title: Association between dietary patterns, anthropometric status, lifestyle, and bone mineral density among postmenopausal women in Taiwan: a cross-sectional study **Background and objectives:** Dietary patterns influence bone health status. Decreased bone density often occurs in the postmenopausal women because of estrogen deficiency. The aim of this study was to investigate the association between dietary patterns, anthropometric status, lifestyle, and bone mineral density among postmenopausal women in Taiwan. **Methods:** A total of 10,451 postmenopausal women aged between 45 and 94 years who measured bone mineral density were recruited from Mei-Jau Health Institution from 2001 to 2015. The sociodemographic data, lifestyle, medical history, and dietary habits were collected by self-report questionnaires. Anthropometric data including body mass index (BMI), waist-to-hip ratio, and body fat were measured. Dietary intake was assessed using a validated food frequency questionnaire composed of 85 closed-ended questions, and intake frequency was identified for 22 food groups. Principal component analysis (PCA) was used to identify the dietary patterns. Multinomial logistic regression analysis was performed to determine the association between dietary patterns, anthropometric status, lifestyle, and bone mineral density.; fired-processed dietary pattern, vegetables dietary pattern, and dairy-grain dietary pattern. **Results:** Three dietary patterns including fired-processed, vegetables, and dairy-grain dietary patterns were derived by PCA. After full adjustments for confounders, participants who were awakened easily or hard to sleep were associated with a higher risk of osteoporosis by 22% (OR=1.22, 95% CI 1.07, 1.18) or 34% (OR= 1.34, 95% CI 1.15, 1.56), respectively. Underweight was significantly correlated with higher odds of osteoporosis (OR=2.02, 95% CI 1.57, 2.60) compared with normal BMI. Central obesity was negatively associated with the risk of osteoporosis (OR=0.59, 95% CI 0.51, 0.68). Participants in the higher quintile (Q4) of the dairy-grain dietary pattern were less likely to have the risk of osteoporosis (OR=0.73, 95% CI 0.60, 0.90) compared with those who were in the reference group (Q1). **Conclusions:** The dietary pattern with high intakes of milk, dairy products, and grains is inversely associated with a risk of osteoporosis. Furthermore, the incidence of osteoporosis is positively associated with underweight and poor sleep quality.

Keyword: dietary patterns, bone mineral density, postmenopausal women

Conflict of Interest Disclosure: N/A

Further Collaborators: N/A

PAB(T6)-261

The South East Asian Nutrition Surveys (SEANUTS) Malaysia: Changes in eating habits of Malaysian primary schoolchildren aged 6-12 years over a decade

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Background and objectives: Accelerated modernisation and urbanisation in developing countries nurtures unhealthy eating habits in populations. Unhealthy eating habits, including meal skipping, are linked with poorer diet quality and central adiposity. Thus, this study aims to investigate the changes in eating habits, in terms of main meal intake and snacking habits by socioeconomic factors amongst Malaysian primary schoolchildren over a decade (years 2010-2020).

Methods: A total of 1429 children aged 6-12 years (SEANUTS I) from the entire Malaysia and 1183 children (SEANUTS II) from Peninsular Malaysia were included. Questionnaires were used to identify socioeconomic characteristics and eating habits. Complex sampling Pearson chi-square test was performed to determine the changes in eating habits.

Results: Approximately one-half and two-thirds of schoolchildren had three main meals [SEANUTS I 54.0% (95%CI 50.5-57.5); SEANUTS II 50.5% (95%CI 46.9-54.1)] and breakfast [SEANUTS I 64.4% (95%CI 61.0-67.8); SEANUTS II 66.2% (95%CI 62.7-69.5)] daily, respectively. Lower consumption of lunch [84.7% (95%CI 82.0-87.1) to 79.2% (95%CI 76.2-81.9), p<0.01] and dinner [80.8% (95%CI 77.8-83.4) to 73.8% (95%CI 70.5-76.9), p<0.01] were observed in 2020. A reduction trend was demonstrated in the daily three snacking habits which decreased from 19.6% (95%CI 16.7-22.7) in 2010 to 6.7% (95%CI 5.1-8.6) in 2020 (p<0.001). Less children consumed morning tea (29.7% 95%CI 26.6-33.0) and supper (16.5% 95%CI 14.0-19.4) daily as compared to 2010 [morning tea: 44.3% (95%CI 40.9-47.8), p<0.001; supper: 27.5% (95%CI 24.3-30.8), p<0.001]. A drastic decrease in the proportion of regular main meals consumption was observed amongst those living in rural areas [52.8% (95%CI 46.8-58.8) to 40.0% (95%CI 33.7-46.7), p<0.01], lower household income [49.4% (95%CI 44.2-54.5) to 34.1% (95%CI 27.4-41.6), p<0.01] and paternal secondary education [51.9% (95%CI 47.5-56.2) to 43.7 (95%CI% 38.8-48.6) p<0.001]. Lower proportion of three snacks, morning tea and supper consumption in 2020 were associated with all socioeconomic factors.

Conclusions: Over the past decade, irregular main meal consumption has worsened amongst Malaysian primary schoolchildren. Meal skipping is increasingly observed among children in rural areas, lower household income, and those whose father had secondary education. There is an urgent need to continuously promote healthy eating habits to children and their parents.

Keyword: Children, Eating Habits, Malaysia, Main Meals, Snacking Habits

Conflict of Interest Disclosure: Ilse Khouw is an employee of FrieslandCampina. All other authors declare no conflict of interest.

PAB(T6)-262
A study of the association between depression, diet quality, and metabolic syndrome in Korean adults

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Background and objectives: Several previous studies suggested the possibility that has a relationship between depression and metabolic syndrome (MetS) based on having an unhealthy lifestyle such as low diet quality or sharing a physiological mechanism. Thus, this study investigated associations between depression, diet quality, and MetS, and whether diet quality modifies or interacts with an association between depression and MetS.

Methods: We analyzed using the data from 13,539 Korean adults aged 19 to 80 in 2014, 2016, and 2018 Korea National Health and Nutrition Examination Survey (KNHANES). Participants were divided into three subgroups according to depression severity levels (normal, mild, moderate to severe) based on the PHQ-9 (The Patient Health Questionnaire-9) score and overall diet quality to the KHEI (Korea Healthy Eating Index) score. We used complex sample multiple logistic regression to estimate ORs and 95% Cis. Diet quality levels further stratified models to explore whether diet quality modifies the association between depression severity and metabolic syndrome.

Results: Depression severity was significantly associated with the risk of MetS (p trend=0.006). However, an association did not exist between diet quality and MetS (p trend=0.064) after adjustment for age, sex, drinking status, education level, energy intake, and physical activity. The moderate to severe group showed a higher risk of MetS (OR: 1.723, 95% CI: 1.238-2.398) and abdominal obesity (OR: 1.699, 95% CI: 1.028-2.808) compared with the normal group only in the lowest diet quality group (T1). The associations between depression severity and MetS disappeared in the second (T2) and third (T3) tertiles of diet quality groups.

Conclusions: Our results suggest that a healthy diet could offset the increased risk of MetS for those with moderate to severe depression in the general Korean adult population.

Keyword: metabolic syndrome, depression, diet quality, Korean Healthy Eating Index (KHEI)

PAB(T6)-263
Associations of MIND diet with cognitive function in the Japanese population: the Suita Cohort Study

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Background and Objectives: MIND (Mediterranean-DASH Intervention for Neurodegenerative Delay) diet is a healthy dietary pattern combining the Mediterranean diet and DASH (the Dietary Approaches to Stop Hypertension) diet and reportedly beneficial for delaying cognitive decline in older populations. However, its favorable effects are reported mainly in the US populations, and it effects for the Japanese population are unknown. The objective of the present study was to investigate associations of MIND diet with cognitive function in the Suita Cohort Study.

Methods: The Suita Cohort Study is following the urban-dwelling general Japanese population. A total of 1,503 participants correctly responded to questionnaire for MIND diet scoring. Among them, 103 participants (aged 75-90 years; 49% men) had recently been tested with Japanese version of Montreal Cognitive Assessment (MoCA-J) together with regular medical check-up.

Results: The average MIND scores (0-15; higher score is considered to be favorable to delay cognitive decline) were 8.93 for men and 9.69 for women. The average MoCA-J scores (the full score is 30) were 23.8 for men and 24.5 for women. Linear regression analysis demonstrated no association between MIND diet score with MoCA-J score (r = 0.139). Then, we analyzed associations between each score out of 15 dietary items of MIND diet with MoCA-J score. Five dietary items exhibited negative correlations, which were the opposite correlations observed in reported populations. For instance, frequent intake of red meat was favorable in this cohort, while less intake of red meat was favorable in previous reports. We modified MIND score using 10 dietary items, which exhibited positive correlations with MoCA-J score. Linear regression analysis demonstrated a modest but significant association between modified MIND diet score with MoCA-J score (r = 0.259, p = 0.008).

Conclusions: Favorable dietary patterns to delay cognitive decline may vary depending on the population and need to be modified accordingly.

Keyword: MIND diet, cognitive function, the general Japanese population

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-264

Relative caloric price of food groups is associated with dietary intake of children 6-23 months of age at the subnational level. Evidence from UN WFP's Fill the Nutrient Gap assessments.

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Background and objectives: Understanding food environments and how they shape dietary and nutrition outcomes is key to transforming food systems for healthy, sustainable diets for the most vulnerable. Using subnational data from 28 LMIC countries, we explore how availability, relative and absolute food price relate to dietary intake of young children.

Methods: We utilize subnational price data from 28 FNG assessments, carried out between 2015 and 2021. We calculate minimum relative caloric price (RCP) of food groups, using the cheapest caloric price per food group and caloric price of local staples, identified by stakeholders at the subnational level. Accounting for datatype and country-level effects, we estimate the relationship between subnational food group information (relative price, absolute price, number of foods) and dietary intake indicators of children 6-23 months old (obtained from DHS or MICS surveys).

Results: Relative caloric price is negatively associated with dietary intake of children 6-23 months old on the subnational level, market assortment shows positive association to the same indicators. Specifically, the proportion of children that consumed a minimum diverse diet shows association with the RCP of eggs, fish, green leafy vegetables (GLV) and meat. Percentage of children that consumed iron-rich foods is associated with the RCP of eggs, fish and meat. Intake of Vitamin A is associated with RCP of GLV, meat, fish and fruit. No significant association was found for absolute price of the same food groups. The variation of subnational RCP within a country can be as high as the variation across countries.

Conclusion: We provide evidence that relative caloric price and market assortment are better predictors of dietary intake for children under two years of age than absolute price. This indicates that the food environment restricts individual choice because of market assortment. Furthermore, the association of child dietary diversity with relative prices suggests that relative price of foods affects the choices households (can) make. The heterogeneity of food environment indicators within countries is an urgent call to pay close attention to deprived areas within low and low-middle income countries, where compounding of risk factors leads to poor nutrition and health.

Keyword: Nutrition, Food environment, Dietary intake, Food prices, Child dietary diversity

PAB(T6)-265

Chrononutrition behavior of young adults in Malaysia

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Background and objectives: Chrononutrition is the interplay between nutrition and circadian rhythm. The emerging field of chrononutrition provides valuable information on how we manage food intake across the day. Additionally, the timing of meals and eating misalignment may impact an individual's adiposity. Therefore, this study aimed to investigate the potential association of chrononutrition behavior with Body Mass Index (BMI). Consistent with previous studies, we expected to find significant differences concerning chrononutrition patterns and body weight.

Methods: This is a cross-sectional study among 409 young adults, college students above 18 in Malaysia. The chrononutrition behaviour was assessed using the validated Chrononutrition Profile Questionnaire (CP-Q). Data were collected using an online platform. Participants self-reported their body weight and height. Data analyses were performed using SPSS.

Results: Our participants consisted of 89.5% female, and 10.5% of male (n=409). Participants' mean age is 21.5 ± 2.2 years old, with a mean BMI of 22.4 ± 5.13 kg/m2. The prevalence of underweight, normal, and overweight is 24.7%, 49.4%, and 25.9%, respectively. The chrononutrition behavior revealed that participants took breakfast about four times/week (mean 4.27 ± 2.43 days), and only 135 (33.0%) consumed breakfast daily. The largest meal taken is during lunch (75.8%). The prevalence of night eating is low, where most of the participants (70.9) did not wake up at night to eat. The mean of snacking after the last meal is 3.23 ± 2.01 days. We observed a significant association between BMI and eating window, evening latency, evening eating, and night eating. It was found that the underweight has a poor eating window (>14:00) (p = 0.001), poor evening latency (≦2:00) (p=0.001), poor evening eating (≧23:00) (p=0.002), and poor night eating (≧4 days/week) (p=0.042) as compared to those with normal and overweight BMI.

Conclusions: Underweight young adults are more likely to have poor chrononutrition behavior. This research suggests that nutrition intervention should also focus on the underweight as this population tend to develop poor eating habits.

Keyword: Chrononutrition, chronotype, college students, overweight, young adults

PAB(T6)-266

Health-related physical fitness and body weight status among children aged 6-12 years old in Malaysia: Findings from SEANUTS II

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Background and objectives: Childhood obesity is associated with reduced physical activity (PA) and health-related physical fitness (HRPF), all of which can increase the risk for non-communicable diseases in children. The present study aimed to assess HRPF according to body weight status among children aged 6-12 years old.

Methods: This was a nationwide, cross-sectional study conducted in Malaysia, part of the second South East Asian Nutrition Surveys (SEANUTS II). A total of 1504 primary school children (mean age: 9.6±1.7 years) participated in this study. Bodyweight and height were measured and classified using WHO 2007 BMI-for-age Z-score. HRPF was assessed with the following components: cardiorespiratory fitness (15-meter shuttle run), muscular strength (handgrip strength, standing long jump), muscular endurance (sit-ups), flexibility (V-sit and reach), and body composition (body fat percentage). The body fat percentage was assessed using InBody® body composition analyser.

Results: About 16% and 14% of the children were overweight (OW) and obese (OB), respectively, while 61% were normal weight (NW) and 9% were underweight (UW). NW children (VO_2 peak: 43.5 ml/kg/min) showed best cardiorespiratory fitness compared to OW (VO_2 peak: 41.4 ml/kg/min), OB (VO_2 peak: 40.2 ml/kg/min, p<0.001) and UW children (VO_2 peak: 42.7 ml/kg/min). In addition, NW children demonstrated the greatest lower-limb strength in the standing long jump (NW: 114.8cm vs. UW: 108.7 cm vs. OW: 107.5cm vs. OB: 96.5cm, p<0.001), and the highest muscular endurance (NW: 11 reps vs. UW: 10 reps vs. OW: 10 reps vs. OB: 8 reps, p<0.001) compared to OW, OB and UW counterparts. However, NW children showed lower handgrip strength (11.9kg) compared to children who were OW (14.5kg) and OB (14.7kg), while UW children demonstrated the lowest handgrip strength (10.1kg, p<0.001). No significant difference was found for flexibility among body weight groups. For body composition, UW children had the lowest body fat percentage (13.9%), followed by NW children (19.7%), OW (31.6%), and OB (40.7%, p<0.001).

Conclusions: Compared to normal-weight children, overweight and obese children demonstrated lower cardiorespiratory fitness, lower-limb strength, and muscular endurance. Interventions focusing on increasing PA and improving HRPF among school children are warranted to promote better weight control and overall health.

Keyword: health-related physical fitness, body mass index, body weight status, children, Malaysia

Conflict of Interest Disclosure: Job JM van Leeuwen is an employee of FrieslandCampina. All other authors declare no conflict of interest.

PAB(T6)-267

Ultra-processed food consumption, cancer risk and cancer mortality: a prospective study of the UK Biobank

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Background and objectives: Dietary patterns worldwide are increasingly displaced by many cheap, highly palatable, and ready-to-eat ultra-processed foods (UPFs). Previous research has linked higher UPF consumption to increased risk for obesity, type 2 diabetes, and cardiovascular disease. However, prospective evidence is limited on cancer incidence and cancer mortality. This study aimed to examine the association between UPF consumption and risk for overall and site-specific cancer incidence and cancer mortality in a large and contemporary cohort of British adults.

Methods: The analytic sample included participants of the UK Biobank study who completed one or more web-based 24-hour dietary recalls between 2009-2012. Food items consumed were categorised according to their degree of processing using the NOVA food classification system. Individual UPF consumption were derived as a percentage of total food intake (g/d), averaged across multiple 24-hour recalls. Prospective association was assessed using multivariable Cox proportional hazards models adjusted for baseline socio-demographic characteristics, lifestyle factors, and total energy intake. Baseline menopausal status, use of oral contraceptives, hormone replacement therapy, and parity were additionally adjusted for female-specific cancers.

Results: A total of 197,426 UK Biobank participants (54.6% women) were included. Mean age at baseline was 58.0 (SD=8.0) years and mean UPF consumption was 22.9% (SD=13.3%). During a median follow-up time of 9.8 years, 15,921 individuals developed cancer and 4,009 cancer deaths encountered. Consumption of UPFs was associated with a higher incidence of overall cancer (hazard ratio [HR] per 10% increment in UPF consumption=1.01; 95% CI: 1.00-1.03), gastrointestinal cancer (HR=1.03; 95% CI: 1.00-1.07), lung cancer (HR=1.06; 95% CI: 1.00-1.13), and ovarian cancer in females (HR=1.15; 95% CI: 1.04-1.27). Furthermore, higher UPF consumption (per 10% increment) was associated with higher risk for overall cancer mortality (HR=1.07; 95% CI: 1.04-1.10), gastrointestinal cancer mortality (HR=1.05; 95% CI: 1.00-1.10), lung cancer mortality

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(HR=1.07; 95% CI: 1.00-1.16), and ovarian cancer mortality in females (HR=1.31; 95% CI: 1.14-1.52).

Conclusions: This large UK cohort study presents evidence of positive associations between UPF consumption and risks for incidence and mortality of overall and many site-specific cancers. Consideration of the degree of food processing and lowering UPF consumption is crucially important for cancer prevention.

Keyword: ultra-processed food, food processing, cancer risk, cancer mortality, UK Biobank

Conflict of Interest Disclosure: This work was supported by Cancer Research UK C33493/A29678. Funding IIG_FULL_2020_033 was obtained from World Cancer Research Fund (WCRF UK), as part of the World Cancer Research Fund International grant programme.

PAB(T6)-268
Availability and Accuracy of Nutritionally Relevant Interactive Information Management Tools (IIMTs) in UK Supermarket Websites

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Background: Supermarket websites may provide nutrition information for individual products but also Interactive Information Management Tools (IIMT) which use this data to enable consumers to make nutritionally appropriate food choices by presenting a range of listed products. Given the lack of insight into the nutrition-related aspects of IIMTs within UK supermarket websites, this study aimed to outline the current consumer-facing practices in this area; to describe the availability and nature of nutritionally relevant IIMTs across all major UK retailers and explore their accuracy.

Methods: Products included in four categories (granola, pork sausage, children's yoghurt, and frozen chips) at seven UK supermarket websites were surveyed from May to September 2021. For each category, data was collected on the availability and nature of each website's nutrition-related IIMTs. In addition, the accuracy of IIMTs was evaluated by calculating the percentage of products which were ranked in the correct order when “sorted” by nutrient content (e.g. sugar, fibre, etc.) according to that expected from nutrition information as declared on the individual product's webpage.

Results: A total of 28 category product listing pages were surveyed across the seven supermarket websites. Only three websites provided IIMTs which utilised a variety of nutrition-related product attributes, including “filter” functions based around nutrition claims (e.g. "low sugar”, “high fibre”) (n=2) or “sorted” products according to the content of a specified nutrient (i.e. sugar, salt) (n=1). For the latter, the percentage accuracy of product listings varied across categories (29-58%) and by specified nutrient (20-100%).

Conclusion: This is the first known UK[1] study to describe the availability and nature of IIMTs which use product nutrition-related attributes, as well as indications of their accuracy. Findings can underpin future research evaluating the impact of these tools on consumers' online food choice behaviours and purchases[2].

Keyword: Online Grocery, Nutrition Label Information, Food environments

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PAB(T6)-269
Relationship between obesity and subjective eating speed in elementary school students

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Background and objectives: According to the School Health Statistics Survey conducted in 2020, the proportion of obese children aged 10 years is 14.2% for boys and 9.5% for girls, and the proportion is increasing. The purpose of this study was to examine the relationship between obesity, lifestyle and nutritional intake.

Methods: From the 4th grade of elementary school (94 boys, 96 girls) in 2020 and 2021 at a private elementary school in Nara city, height, weight, body fat percentage, lifestyle questionnaire, brief-type self-administered diet history questionnaire (BDHQ) data was collected. The Rohrer index was calculated from height and weight. Body fat percentage was measured with a body composition analyzer “Inbody” (by bioelectrical impedance analysis method).

Results: The subjects were divided into three groups, less than 115 group (boys: n = 24, girls: n = 29), 115 or more and less than 145 group (n=48 and 52), and over 145 group (n=22 and 15), depending on the Rohrer's index. Among boys, the mean values of body fat percentage increased significantly to 13.1 (S.D. 3.6) %, 21.2 (5.1) %, and 33.0 (3.6) % as the Rohrer's index increased. A similar tendency was seen in girls. Compared to the other two groups, the percentages of students who answered that they were on a diet and who answered that they did not eat snacks were higher in the over 145 group of boys, while the percentages of students who answered that their subjective eating speed was fast and who answered that they did little exercise were higher. There was no association between nutritional intake and physique in both boys and girls.

Conclusions: It was suggested that subjective eating speed and low exercise frequency are involved in boys' obesity.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: obesity, subjective eating speed, elementary school

Keyword: Food Security, Dietary Diversity, Bangladesh, Poverty

Conflict of Interest Disclosure: No

Further Collaborators: No

PAB(T6)-270

Increase in Micronutrient Adequacy in Resource-Poor Areas of Bangladesh through Making Market Works for Women (M2W2): A Quasi-Experimental Study in the Chittagong Hill Tracts

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Background and Objectives: In 2013, Helen Keller Intl's Making Markets Work for Women (M^2W^2) project, funded by UKAID/SHIREE, aimed to reduce food insecurity, malnutrition, and poverty among 2,500 extremely poor households in six unions of Panchari and Dighiniala sub-districts in Khagrachhari District. This presentation outlines the impact M2W2 had on household economy, food security, and diets.

Methods: A quasi-experimental impact assessment among a panel of 470 propensity score matched extremely poor households was undertaken by survey in October 2013 and October 2015 (235 treatment and 235 control). Households were identified through a community wealth-ranking process in both treatment and control villages. Nutrition was measured through dietary diversity, food security was measured using the household hunger scale, household expenditure, and self-reported ownership of household assets.

Results: M2W2 significantly reduced the odds of a household experiencing hunger [OR 0.2, p< 0.002] and increased the quality (i.e., diversity) of food consumption month of adequate household food provisioning [4.75 months, p<0.000]. Women's diets in treatment households significantly improved over control [0.5, p<0.000] with only 0.35 odds of having an inadequate diet [p<0.000]. Treatment households owned significantly more assets at end line compared to control [1.2 items, p<0.003]. The number of total assets mediated 11% of the impact of the treatment effect on household experiencing hunger [p<0.007] and 25% of the impact of the household food consumption score [p<0.000]. M2W2 activities did not impact mean monthly expenditures per person [p<0.34]. However, when controlling the mean monthly expenditure per person, the number of total assets mediated 7% of the impact of the treatment effect on households experiencing hunger and 21% of the impact from the household food consumption score.

Conclusion: The M2W2 project improved women's dietary diversity, the quality of household food consumption, and control of assets while reducing household hunger of extremely poor households. However, expenditures were increased, even when periods of food insecurity were reduced and the asset base of household increased due to M2W2 interventions. Further research is needed to ascertain the long-term impacts of these improved coping abilities to identify the most critical indicators to target for food security, nutrition, and poverty.

PAB(T6)-271

Genetic predisposition to metabolically unfavourable adiposity and risk of prostate cancer: A Mendelian randomization analysis

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Background and objectives: Previous prospective studies have shown that obesity is associated with a lower risk of non-aggressive prostate cancer but higher risk of aggressive forms of the disease. Recent genetic studies have identified genetic variation associated with adiposity coupled with unfavourable and favourable metabolic effect, which could offer insights into the association between adiposity and prostate cancer risk. We aimed to estimate the association of genetically predicted metabolically unfavourable adiposity (UFA) and metabolically favourable adiposity (FA), which are both associated with higher adiposity but have opposite associations with metabolic markers, with prostate cancer risk.

Methods: We used a two-sample Mendelian randomization (MR) approach; data for UFA and FA genetic instruments were from UK Biobank participants, and genetic outcome data were from the PRACTICAL consortium (up to 85,554 cases, 91,972 controls). For the statistical analyses we used the inverse-variance weighted (IVW) method, and also utilised a variety of robust methods and sensitivity analyses to assess the possibility of violation of MR assumptions.

Results: In IVW models, the two-sample MR analyses did not provide evidence that a genetically determined one standard deviation (1-SD) higher UFA or FA was associated with a difference in overall prostate cancer risk [OR: 0.81 (95% CI: 0.64-1.04) and 1.04 (0.80-1.35), respectively]. Methods robust to violations of the MR assumptions were largely consistent with the IVW estimates. Genetically determined UFA and FA were also not associated with advanced or early age onset prostate cancer. Similar estimates were found in the sensitivity analyses conducted to assess the influence of pleiotropy.

Conclusions: Our findings do not support a role of UFA or FA in the development of prostate cancer. Although the UFA and FA genetic instruments did not cover all aspects related to metabolic health, these findings may suggest that the positive association between adiposity and aggressive prostate cancer found in previous prospective studies may be due to differences in detection in men with obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Prostate cancer, Adiposity, Mendelian randomization, Metabolic

Conflict of Interest Disclosure: None

PAB(T6)-272
Biophysical environment and food environment influence on food choices and food security in Breede valley municipality, South Africa

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Background and objective: Food environments are the interface through which people interact with the broader food system. In order to determine the effects of food environments on peoples' food choices, it is crucial to understand what people consume. A cross-sectional study was applied to investigate how bio-physical environment and food environment influence food choices and food security in Western Cape, South Africa.

Methods: A sample of 365 households were randomly selected from the Breede valley local municipality. The bio-physical environment, food environments, food choices and food security status of the participants were assessed, using a questionnaire.

Results: The findings indicated that just over half (51.0%) of the participants were aged 36-55 years. The total monthly household income of over a third ranged from 1 000 to 3 000 South African Rand with salary being stated as the main source of income by over half of the household informants (51.8%). In more than 50% of households, food often available included staple foods, vegetables and meat products. Cereals (92.8%), white tubers and roots (31.1%) were the most consumed starches. There was a lower consumption of vitamin A-rich foods (37.6%) compared to dark green leafy vegetables (45.3%). The findings revealed that the households did not struggle to access fruits and vegetables as a total of 68.3% of the households always had easy access to fruits and 74.9% to vegetables. Three quarters (75.1%) of the households were found to be food insecure with almost half (45.5%) being moderately food insecure. The findings showed that the most used coping strategy was relying on less preferred and less expensive foods by 76.1% of the households during times of food shortages.

Conclusions: The study revealed that households had different types of foods from all 17 food groups. The dietary diversity was low in most households, with more than half of the households being food insecure. Biophysical and food environments had influence on food choices and nutrition transition in the study area.

Keyword: HFIAS, Nutrition , Dietary Diversity, Fruits and vegetables , Households

Conflict of Interest Disclosure: No conflicts of interest to disclose

PAB(T6)-273
Differences in vegetable consumption between day workers and sift workers: analysis from the 2018 National Health and Nutrition Survey, Japan

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Background and objectives: Health problems can be caused by severe working conditions, such as shift work. There are indications of an association between shift work and a major risk factor for disease onset. We hypothesized that there may be differences in the eating behaviors between day and shift workers, and that these differences may induce disease. We therefore conducted a secondary analysis of the 2018 National Health and Nutrition Survey (NHNS) data.

Methods: Of the total participants in the 2018 NHNS, 6,739 participants were aged ≧ 20 years. For the present analysis, we excluded participants who were unemployed and those without dietary information. The final participants consisted of 3,213 Japanese adults (1,755 men and 1,458 women). A non-parametric test was used to determine potential relationships between the eating behaviors and employment type, day shift or not. Food group and nutrient intakes were adjusted for total dietary energy intake using the density method and the residual method, respectively.

Results: Among night and shift workers, men consumed more wheat and processed foods and fewer green and yellow vegetables, while women consumed fewer green and yellow vegetables, although there were fewer items with differences compared to men. Regarding the amount of nutrients, men who work irregular hours have a low intake of potassium, vitamins, and folic acid, possibly due to a low intake of green and yellow vegetables, while women have fewer items with differences compared to men, and like men, they have a low intake of protein.

Conclusions: There is a large body of research evidence suggesting that high vegetable intake may prevent a variety of health outcomes. Therefore, the fact that night and shift workers have a low intake of green and yellow vegetables may be associated with one of the health problems.

Keyword: shift work, vegitable, National Health and Nutrition Survey, Japan

PAB(T6)-274

Children's exposure to sugars and non-sugar sweeteners (NSS) in non-alcoholic beverages (NAB) marketed on television in Sri Lanka

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Background and Objective: Unhealthy non-alcoholic beverages (NABs) increase risk of diet-related overweight/obesity leading to non-communicable diseases (NCDs). Yet NABs are marketed to children in Sri Lanka despite the policies in place. This study intended to explore the total, added and hidden sugars and non-sugar sweeteners (NSS) in NABs marketed on television targeting 4-15 year-olds.

Methods: Advertisements (n=1518), aired in top three popular TV channels for 33 hours (three hours of children's peak viewing time (PVT) and eight hours of non-PVT in each channel), were analyzed based on the International Network for Food and Obesity/NCDs Research, Monitoring and Action Support (INFORMAS) protocol and the Sri Lankan nutrition profile model (SL-NPM). The data were analyzed using SPPS.

Results: Twenty three products were identified among 130 NAB advertisements; tea products (n=8), malted beverages (n=4), milk drinks (n=3), follow-up milk (n=4), juices (n=2), a carbonated drink, and an energy drink. More NAB advertisements were noted during the PVT than NPVT, with a ratio of total NAB advertisements per hour during PVT and NPVT of 3:2. According to SL-NPM, only 9/23 NABs were permitted; eight tea products and one malted beverage. Six products were not-permitted, while four had insufficient nutrition information to code. The manufacturer recommended total sugar intake per day (based on serving size and number per day) from these NABs was 1.5 to 4 teaspoons. Nearly 42% of the NAB advertisements were on products with added sugars (maltodextrin, lactose, sucrose, glucose). Over half (54.61%) of advertisements displayed claims related to sugars, some of which were misleading. For example 'No added sugar' was claimed in malted beverages where the sugars from malt extracts were hidden. NABs containing NSS (Steviol glycosides-INS 960) (n=2) restricted by the food act and follow-up milk (n=4) for children aged <36months, which is not recommended by the Sri Lanka breastfeeding code and were marketed. Worrisomely, these products were frequently aired, which accounted for nearly 1/4 of total NAB advertisements (32/130).

Conclusion: Marketing of unhealthy NABs, particularly with unacceptable sugar levels, hidden sugars, misleading claims and NSS for children is of great concern. It should be urgently restricted.

Keyword: Total sugar and Added Sugars, Non-sugar sweeteners (NSS) , Non-alcoholic beverages (NAB), Unhealthy, Children

Further Collaborators: Funding information: International Development Research Center, Grant Number: 109170

Acknowledgement: INFORMAS Research team, the project leader and the secretariat

PAB(T6)-275

Climate friendly and nutritionally adequate? An explorative case study using mathematical optimization on the Danish diet

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Background and objectives: Optimizing our food consumption plays a key role in the necessary global climate change mitigation. The objective of this study was to investigate how much the greenhouse gas emissions (GHGE) of the Danish diet can be reduced theoretically by changing dietary composition, while ensuring that the diet is nutritionally adequate.

Methods: Linear programming was used to obtain the optimal quantities of foods aggregated into 57 food sub-groups to minimize diet-related GHGE emissions of a 10 MJ diet. We compared to the current average diet of the adult Danish population, based on dietary intake data from Danish National Survey of Diet and Physical activity 2011-2013. Nutritional adequacy was ensured by constraining the model for content of 24 micro- and macronutrients according to the Nordic Nutrition Recommendations. The amounts of water, spices and condiments were set to represent amounts in the current diet, due to their supporting role in the diet and uncertainties in GHGE estimates of these products. The GHGE of the optimized diet was compared to the GHGE of the current average diet of the adult Danish population.

Results: These preliminary results indicate that it is theoretically possible to compose a nutritionally adequate diet with a GHGE of 1.12 kg CO_2-eq /10 MJ, resulting in a 75% GHGE reduction compared to the current diet. In addition to water spices, and condiments the obtained diet contained approximately 410 g of oats, 50 g of dried beans, 240 g of low-climate impact fish, 2 g of nuts, 150 g of skimmed milk, 90 g of dark green vegetables, and 70 g of other vegetables.

Conclusions: This study shows how a substantial GHGE reduction of 75% can be obtained while achieving nutritional adequacy of the Danish diet, establishing the theoretical lower limit for the GHGE of the diet. However, the optimized diet is unrealistic and cultural acceptability severely compromised. Our future optimizations will include additional aspects of health, food safety and cultural acceptability, as well as analyses of the trade-offs between these aspects and GHGE, in order to facilitate the population's transition towards a sustainable healthy diet.

Keyword: Sustainability, Mathematical optimization, Linear programming, Dietary patterns, Nutrient recommendations

PAB(T6)-276

Self-reported dietary changes among adults with type 1 and type 2 diabetes during the first wave of the COVID-19 pandemic in the UK

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Background and objectives: The COVID-19 pandemic placed restrictions on movement, travel and access to shopping facilities (1) as well as enforcing behaviour and lifestyle changes for many. Our aim was to evaluate changes to the dietary behaviours of adults living with type 1 (T1DM) or type 2 (T2DM) diabetes in the UK during the first wave of the COVID-19 pandemic.

Methods: An online survey was sent to >11,000 people over 18 years old who had previously volunteered to take part in research. The survey was live between 6th July and 31st August 2020 and included questions on lifestyle factors, including diet.

Results: 4764 people completed the survey, of whom 26% had T1DM and 59.9% had T2DM. 72.4% of people with T1DM, and 86.6% with T2DM, reported at least one comorbidity. Only 2.4% of the total cohort reported being diagnosed with COVID-19 at any time up until completing the survey. Although 33.1% of all respondents reported eating more in general, there were no statistical difference in changes between individuals with T1DM, T2DM, or other/no health conditions. T1DM was associated with more reported weight gain whereas T2DM was associated with reported weight loss ($p < 0.001$). Compared to people with T1DM, those with T2DM reported significantly higher consumption rates of fresh foods ($p=0.002$), sugary foods ($p=0.011$) and alcohol ($p<0.001$). There was no difference across groups in reported rate of skipping meals, changes to meal timings, rates of home cooking, or binges on sweet foods.

Conclusions: This survey suggests that changes in eating behaviours during eating during the first wave of the COVID-19 pandemic in the UK were heterogenous and varied significantly between groups with T1DM, T2DM, and other or no health conditions. The differencial effects of global events like the COVID-19 pandemic on diet and nutrition must be taken into consideration when planning national and international policy responses.

Keyword: COVID-19, Diet, Lifestyle, Diabetes, Behaviour

Conflict of Interest Disclosure: CS is employed by DDM which owns and operates Diabetes.co.uk which is the platform we used to recruit participants to complete the survey.

Further Collaborators: Thanks to Louise Haines and Sarah Armes for their contributions to the research.

PAB(T6)-277

Association of diet and risk of being overweight/obese among Nigerian adults: evidence from a nationally-representative survey

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Background: Overweight is a global health problem linked to noncommunicable diseases (NCD). Prevalence in Nigeria, like other African countries, is high. In 2020, 25% of adults were overweight or obese and rates are increasing. Overweight/obesity is found with other nutrition problems such as undernutrition and micronutrient deficiency. This analysis aims to identify the association of diet and overweight risk among Nigerian using the most recent nationally-representative data. **Methods:** This study was a secondary data analysis of the 2018 Nigeria Demographic and Health Survey. This was a cross-sectional survey carried out to monitor the health of women (15-49y) and under-five year-old children in Nigeria. A total of 12904 women (aged 15-49y) with data on body mass index were included. A 12 point Nigerian healthy diet score was created, adapted from the African and Caribbean Eat-well guide. We ran logistic regression analysis, adjusting for confounders, to examine associations of the Nigerian healthy dietary score with overweight/obesity.

Results: The prevalence of overweight/obesity was 28%. Women in the oldest age group (45-49y) had lower rates of overweight/obesity (10%) compared to the youngest age group (15-19y) at 20%. Overweight/obesity was also higher with higher education and wealth indicators. Women living in urban areas, being married, TV watching, contraceptive use were all associated with higher rates of overweight/obesity. Muslim women had lower rates (19%) compared to Christian women (38%). In our fully adjusted model, each increase in the Nigerian healthy dietary score was found to be associated with a 5% increase (OR 1.05, 95%CI 1.01, 1.08) in the odds of overweight/obesity. **Conclusion:** Diet and some sociodemographic factors have significant associations with overweight in Nigeria. This knowledge highlights the importance of interventions targeted at these factors to reduce the risk of overweight/obesity in Nigeria and contribute towards meeting the United Nations Agenda 2030 NCD reduction target.

Keyword: Overweight, Obesity, Diet, DHS, Nigeria

PAB(T6)-278

Comparing different sources of data to estimate per capita cereal grains consumption among total population in Kenya and Bangladesh

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Background and objective: Fortification of cereal grains, including wheat flour (WF), maize flour (MF) and rice (R), is a proven and cost-effective intervention to address micronutrient deficiencies. Estimating accurate cereal grains consumption ensures reliable food fortification program design, and reach, coverage, and impact assessment. The objective was to compare different sources of data that report cereal grains consumption among total population in Bangladesh and Kenya.

Methods: Data received from the following were analyzed and compared across three approaches: 1) Existing dietary/proxy surveys; 2) Milling associations on grains available for human consumption; 3) FAO's food balance sheet. For approach 1, Bangladesh Household Income and Expenditure survey 2010 (BHIES) and Kenya National Micronutrient Survey 2011 (KNMS) data were used. For approach 2, information provided by milling associations on the amount of cereal grains available annually for human consumption in both countries was used. For approach 3, FAO data on per capita amount of cereal grains available in Bangladesh and Kenya for human consumption was used.

Results: Among all population groups, average (mean) consumption of grains in Bangladesh was 34.7 (WF) and 423.8 (R) grams/capita/day (g/c/d) respectively, and in Kenya, was 56.9 (WF), 171 (MF) and 21.1 (R) g/c/d respectively (approach 1). Grains available in Bangladesh from mid-2018 to mid-2019 was 109 g/c/d (WF) and 599.8 g/c/d (R), and in Kenya in 2018 was 116.8 g/c/d (WF), 245.7 g/c/d (MF) and 58 g/c/d (R) (approach 2). Supply of wheat/wheat products, maize/maize products, and rice/rice products in Bangladesh from mid-2018 to mid-2019 was 51.2 g/c/d, 1.9 g/c/d and 711.5 g/c/d respectively, and in Kenya in 2018 was 110 g/c/d, 206.5 g/c/d and 60 g/c/d respectively (approach 3).

Conclusion: In both Bangladesh and Kenya, cereal grains consumption estimates from dietary/comparable surveys was lower than those received from milling associations and FAO food balance sheet. These findings show that fortification program design, and the potential coverage, reach, and impact of fortified grains can vary based on the source of grain intake data and should be reviewed using several sources of data available for the country of interest.

Keyword: Dietary intake, Food fortification, Wheat flour, Maize flour, Rice

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T6)-279

Maternal depression and child feeding practices: Determinants to malnutrition among young children in Malaysian rural area

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Background and objective: Maternal depression may affect child feeding practices and growth. The objective of this study is to determine the relationship between child feeding practices and current maternal depression with malnutrition among young children in a rural community.

Methods: This is a case controlled study consisted of 52 Malay mothers of malnourished children (cases) and 50 Malay mothers of well-nourished children (controls) in Kuala Langat, Selangor, Malaysia. Structured questionnaires on child feeding practices and Beck Depression Inventory Second Edition (BDI-II) questionnaire were distributed to mothers.

Results: Depressed mothers stopped exclusive breastfeeding (2.8 ± 2.1 months) earlier than non-depressed mothers (3.7 ± 2.0 months) ($p = 0.045$). Binary logistic regression analysis showed current maternal depression was a primary contributor associated with risk of malnutrition in children (AOR 2.5, 95% CI 1.08 – 6.09), and followed by the number of children (AOR 1.3, 95% CI 1.02 – 1.77). Mothers who experienced depression were twice as likely to have malnourished children. Each additional child in the family will increase the risk of malnutrition by 1.3 times.

Conclusions: Maternal depression is associated with child feeding practices and a risk factor to malnutrition among young children in the studied population. Preliminary screening to identify depression symptoms should be conducted to all mothers as early as the first trimester to prevent the incidence of malnutrition in children.

Keyword: child feeding practices, malnutrition, maternal depression, underweight, young children

Conflict of Interest Disclosure: The authors have no conflict of interest to declare. This manuscript has not been published and is not under consideration for publication elsewhere.

PAB(T6)-280

Integrating Growth Monitoring and Promotion into the Expanded Programme on Immunization in Four Rural Districts in Bangladesh: A Government Initiative

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Background and objectives: The Government of Bangladesh started National Nutrition Services (NNS) in 2011 to mainstream nutrition through health system platforms. However, Growth Monitoring and Promotion (GMP) is still not operational as a preventive service. The 2020 mid-term review of the Health Sector Program prioritized integration of GMP into the Expanded Programme on Immunization (EPI). NNS requested technical assistance (TA) from Alive & Thrive (A&T) in December 2020 to operationalize integration and test feasibility for at-scale system uptake. Early implementation of this TA will end in August 2022.

We aim to describe the process for integrating GMP into the EPI platform, and A&T TA role in health system strengthening to operationalize this.

Methods: A&T identified areas of TA drawing on learnings from its previous system strengthening activities and formative research informing design of interventions to strengthen routine nutrition services. National and global evidence base informed the design of a feasible approach for services integration. Government and A&T reports and mixed monitoring data were used to describe the integration process.

Results: The integration process started in December 2020 following 6 steps: co-design workshops with government; development of technical resources; advocacy and sensitization; training of trainers; training of providers and supervisors; integrated service delivery. A COVID-19 surge slowed down the activities in 2021. Three co-design workshops informed the integration design. Technical resources include an operational guide; training materials; tools for monitoring, supportive supervision and use of data. The high-level sensitization meeting included 34 officials from relevant directorates in the Ministry of Health and Family Welfare (MoHFW) with responsibilities at national and sub-national levels. Training covered 316 providers. During February-March, 66% of EPI centers provided integrated service. Of the EPI target children, 97% were weighed; for 52% length was measured; and 98% of caregivers received age-appropriate nutrition counseling.

Conclusions: With strong coordination within the MoHFW and well-designed TA, it was feasible to integrate GMP into EPI service. The initial findings indicate that integration of this preventive nutrition service across the national EPI platform, one of the most accessible and effective community-based services, is feasible. A cross-sectional evaluation of the integration process is on track to inform national scale up.

Keyword: Growth Monitoring and Promotion, Expanded Programme on Immunization , Service Integration, Health System Strengthening

Conflict of Interest Disclosure: No conflict of interest

Further Collaborators: Not applicable

PAB(T6)-281

Weight change is associated with stress, dietary habits, and sleep quality among Saudi adults under home confinement during COVID-19 outbreak

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Background and Objectives: The coronavirus disease 2019 (COVID-19) pandemic has forced Saudi Arabia to implement a range of measures including curfew, mandatory home confinement, banning the entry of many cities, and suspended religious activities. The Western region had more restrictions compared to other cities. This study aimed to assess the lifestyle changes and psychological impact of COVID-19 before and during home confinement and explore the associations between weight change, dietary habits, and stress.

Methods: A cross-sectional study was conducted on Saudi adults using an online survey administered in Arabic and English languages. Pregnant and lactating women and those living outside Saudi Arabia were excluded. Data on demographics, dietary habits, and physical measurements were collected. Sleep quality was assessed using the Pittsburgh Sleep Quality Index. Stress was assessed using a subscale in Calgary Symptoms of Stress Inventory.

Results: A total of n=271 participants were included in the analysis. Of these, 85% were females and 46% had BMI ≧25 kg/m^2. About 80% were under lockdown for >40 days and 72% were from the Western region. During home confinement, 31% reported decreased weight and 27% increased weight. A significant association was found between increased weight and confinement >40 days. Stress scores and screen-time significantly increased, whereas sleep quality and number of days spent in walking decreased during confinement than before confinement. In multiple linear regression, higher stress scores before confinement were negatively associated with age. Stress scores during confinement were positively associated with stress scores before confinement while negatively associated with age. In multiple logistic regression, the odds of gaining weight during confinement were higher with higher stress scores and consuming ≧4 meals than consuming 1-2 meals; however, the odds of gaining weight was lower with increased days spent in moderate activity. The odds of losing weight were higher with poorer sleep quality and increased days spent in moderate activity, but the odds of losing weight was lower with consuming >2 snacks and consuming 3 meals compared to 1-2 meals.

Conclusion: Home confinement negatively impacted stress, sleep quality, physical activity and weight status among Saudi adults. These factors could be addressed in future restrictions to improve individual's wellbeing.

Keyword: COVID-19, Saudi Arabia, sleep quality, weight, stress

PAB(T6)-282

Intakes of micronutrients and heavy metals in stunted and non-stunted under-two children in urban and rural East Nusa Tenggara, Indonesia: a study using duplicate portion sampling and nuclear analytical technique

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Background and objectives: Many studies reported micronutrient intakes of stunted and non-stunted children, but little is known about their intakes of trace elements and heavy metals. Nuclear analytical technique (NAT) can assess micronutrients and heavy metals in food samples which are difficult to estimate using dietary assessment given the limitations in food composition tables. This study aims to compare intakes of micronutrients and heavy metals in stunted and non-stunted under-two children in urban and rural East Nusa Tenggara (NTT), Indonesia using NAT.

Methods: Stunted (length-for-age <-2.00) and non-stunted under-two children, matched for sex and age, were recruited in NTT: Kupang (urban, n=186) and Timor Tengah Selatan (TTS) (rural, n=214). Two-day 24-hour dietary recalls (24HRs) were done, and duplicate-portion samples were collected based on foods consumed on the 1st day of 24HRs. Two NATs were used, neutron activation analysis (NAA) to assess Se, Fe, Zn, Cr, Co, Hg and total X-ray Fluorescence (XRF) to assess Ca, Cu, Pb.

Results: Compared to their normal counterparts, stunted children had lower intakes of Ca (12-23mo, both sites, p=0.006) and Fe (6-11mo, TTS, p=0.045). There was no difference in Zn and Se intakes between stunted and normal children. Intakes of heavy metals were higher in Kupang than TTS for Pb (12-23mo, p=0.019) and Cr (6-11mo, p=0.011; 12-23mo, p=0.016). On the other hand, exposure to Hg was higher in TTS than Kupang (6-11mo, p<0.001; 12-23mo, p<0.001) at the level close to the provisional tolerable daily intake. There was no significant difference in exposures to Co and Cu between Kupang and TTS.

Conclusions: The study found that stunted children in both sites had lower Ca and Fe intakes. There was significant difference in exposures to Pb, Cr and Hg between sites. The findings suggest the importance of assessing not only nutrient intakes, but also exposures to heavy metals known to have negative consequence to health and nutritional status. Further study to identify potential food sources as contaminants of Hg particularly in TTS is recommended.

Keyword: Stunting, Micronutrients, Heavy metals, Duplicate portion sampling, Nuclear analytical technique

Conflict of Interest Disclosure: The Authors declare that there is no conflict of interest

PAB(T6)-283

Frequency of milk consumption among the adult population of Aktobe city and a comparative evaluation of the results of laboratory studies of milk

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Background and objectives: Milk is one of the main products of the consumer basket, and has specific characteristics due to its chemical and microbiological composition. The aim of the research is assessment of the frequency of milk consumption among the adult population and a comparative assessment of the results of laboratory studies of milk sold in the consumer market of the city of Aktobe.

Methods: The research was approved by the Local Ethics Commission of the West Kazakhstan Marat Ospanov Medical University in Aktobe city, Republic of Kazakhstan. The research involved 461 adults. The experimental part of the work was carried out using the method of capillary electrophoresis, chromatographic, voltammetric, spectrophotometric, titrimetric methods.

Results: According to the frequency of milk consumption: 369 people consume daily, which accounted for 79%, and 6 people who do not consume milk at all-1%. For the most commonly used milks, using the Spearman power correlation coefficient, milk number 8 accounted for a maximum of 20% of all milks, and milk number 16 was the least consumed, which was 0.6%. Total for 2021-2022 57 samples of pasteurized drinking milk of various fat content were studied, of which 7 samples did not meet the requirements of regulatory documents for physical, chemical and organoleptic quality indicators. In 7 rejected samples, the mass fraction of protein was underestimated by 20-45%, the mass fraction of dry skimmed milk residue - by 7-12%, density - by 1-2%. For 2 years, the share of products that do not meet the requirements of regulatory documents in terms of quality indicators, identified during laboratory tests, amounted to 3.7%.

Conclusions: It was found that adult residents of Aktobe often consume milk, and women are 68% more likely than men. Based on the results of the control and surveillance activities carried out in 2021-2022, 7 milk samples were rejected.

Keyword: milk , nutrition, frequency of milk consumption, identification of inconsistencies, analytical research methods

Conflict of Interest Disclosure: no

Further Collaborator: no

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-284
Estimating the affordability of Indonesian dietary guideline

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Background and Objectives: Dietary guideline is developed to guide a healthy diet. However, healthy diet not always affordable to certain groups. This analysis is aimed to estimate the cost of following the Indonesian dietary guideline, and analyze its affordability to Indonesian population. **Method:** Modified Cost of Recommended Diet (CoRD) method was applied to calculate the cost of following the Indonesian dietary guideline. A household of 4, consist of children aged 12-23 months, adolescent girl aged 15-16 years, moderately active lactating women aged 30-39 years, and moderately active men aged 30-59 years was set for the calculation. We review the guideline and extract information on quantifiable portion size suggestion for each age group and each food groups, i.e. staple foods, animal source protein, plant source protein, vegetables, fruits, sugar, oil, salts and water. For each food groups, local food items were listed, and the price were obtained from the most recent national consumer price data available from the national statistical agency. For each foods, the price was adjusted to raw-cooked conversion factor and percent of edible portion. To calculate the cost per day, in staple, animal source, plant source protein, and fruits groups, the average of 2 lowest cost food items were calculated. In vegetable group, the average price of three lowest cost food items (1 dark green leafy vegetable and 2 other vegetables) was taken. The cost per person per day for all food groups were summed to obtained the cost of Recommended Diet. **Results:** The cost of Recommended Diet for Indonesian is IDR 29,339.5/person/day (USD 2/person/day) or IDR 880,186/person/month, which is relatively comparable to those in low and lower middle income countries (Hirvonen et al, 2020). However, this cost is higher compared to the national average of household food expenditure, i.e. IDR 572,551/person/month, indicating that healthy diet may not be affordable for many Indonesians. The cost was also varied across provinces, with the 3 highest were South Kalimantan, West Papua, and Riau Islands. **Conclusion:** The Indonesian dietary guideline may not be affordable for many Indonesians, as the cost of following the guideline is higher compared to the average household food expenditure.

Keyword: dietary guideline, cost, diet

PAB(T6)-285
Mobilizing European youth to fight childhood obesity. How data from WHO/Europe COSI study and initiatives from CO-CREATE project are helping to drive policy progress.

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Background and objectives: Over the past two decades, efforts to combat the rising tide of childhood overweight and obesity has taken shape. Data from WHO's European Childhood Obesity Surveillance Initiative (COSI)[1], have improved our understanding of this public health challenge in the WHO European Region, and informed many of the national policy actions to combat obesity in the Region[2,3]</sup>. Additionally, the CO-CREATE[4] European project has engaged young people as active agents in formulating obesity prevention policies. This paper aims to examine national policies and measures against policy ideas formulated by adolescents in five European countries. **Methods:** We examined national policies and areas of action[5] from Portugal, the United Kingdom, the Netherlands, Poland and Norway. These policies were checked for consistency and alignment with several policy ideas developed between CO-CREATE adolescents and relevant stakeholders, across the same countries.

Results: Countries´ policy actions included in Portugal (sugar-sweetened beverage tax, integrated nutrition strategy), United Kingdom (soft drink levy, active commuting programs, urban design principles), Norway (industry and government partnerships to promote healthier foods, nutrition education curriculum for schools), Poland (investing in sports infrastructure), and the Netherlands (preconception and pregnancy care)[4]. Whereas in the CO-CREATE project, adolescents identified four demands that they see as crucial starting points towards ending childhood obesity, namely: 1) Stop all marketing of unhealthy foods to children under the age of 18; 2) Secure all children high-quality, practical based food and nutrition education in school and a healthy school cafeteria; 3) Implement a sugar-sweetened beverage tax to make unhealthy foods more expensive; 4) Offer all children and adolescents free, organized physical activities at least once every week[6].

Conclusions: Although the present work seems to show that the policy responses to COSI data and youth-led policy ideas are on similar path, no country is on track yet to meet the targets set out by international organizations[1]. Thus, further collaborative action, particularly involving young people in shaping the current and future policies is needed, as a key element to tackling this major public health challenge.

Keyword: CHILDHOOD OBESITY, COCREATE, POLICY IDEAS, YOUTH, HEALTH POLICY

Conflict of Interest Disclosure: None

PAB(T6)-286
Feeding practices and nutritional status of urban population in Benin: Current situation in Cotonou, Southern Benin

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Background and objectives: Urbanization often results in a change in eating habits that can affect the nutritional status of individuals. This study aimed at describing the current food habits and nutritional status of urban population living in Cotonou, the biggest town of Benin Republic.

Methods: Literature review and data collection among public primary schools food environment.

Results: Spatial organization of the city requires a large part of the active population to travel daily or weekly between their residence and their place of work. Populations are adopting diets that combine "domestic meals" with "out-of home meal". Consumption of a meal outside home counts for 20% of meals in Cotonou, 18% in other urban areas and only 14% in Benin rural areas. Various places are available to out-of-home catering : gargotes, maquis, restaurants, cafeterias, markets. However, gargotes are the most frequented places. Mobile structures have also recently appeared and offer dishes that are often popular with middle and upper classes. Food production of foreign origin is becoming important and tends to replace small food artisans. Out-of-home catering reaches all social strata including school children. Food vendors are regularly installed in every school. Professional occupations most concerned are: 'handicrafts and small services', 'civil servants and private workers' and 'processing and trade'. The most common meals offered in gargotes are rice, maize, yam, wheat, cassava and beans made. Inadequate sanitary quality of street foods/meals leads to several cases of foodborne illnesses notably diarrhea and gastroenteritis of presumed infectious origin. One hospital (Cotonou CHD) had recorded an average of 365 peoples suffering from these illnesses from 2012 to 2016. There are also non-infectious colitis, bacterial food poisoning, bacterial intestinal infections, intestinal parasitosis, typhoid and paratyphoid fevers. Official statistics in Benin also report an epidemiological situation of emergency of non-communicable diseases, particularly those related to urbanization, sedentary lifestyle and changes in diet. Hypertension affects 27.5% of Beninese and diabetes 4.6%. Overweight and obesity affect 23% and 24% of women of childbearing age respectively. Regarding schoolchildren, 34% are anemic, 13%wasted, 5% stunted and 5% overweighed or obese. A challenge of mult burden is also a concern.

Conclusions: Urbanization has led to hybrid, complex and dynamic food practices in Cotonou. Street food/meal affects all social strata and is at the root of the increase in non-communicable diseases and the Multi burden of malnutrition. Appropriate policies to manage this nutritional transition are needed.

Keyword: Multi burden of malnutrition, Urban areas, Out-of-home foods, Domestic meals, non-communicable diseases

Conflict of Interest Disclosure: None

PAB(T6)-287
Food environment issues that perpetuate food insecurity among university students

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Background and objectives: Low food security (FS) has emerged as a global threat to student success, but few studies have been conducted in Africa. We report on the prevalence of FI in the context of food environment (FE) and academic achievement at a university in South Africa.

Methods*:* In an observational cross-sectional study, an online survey pertaining to pre-lockdown conditions was made available to all students registered at the UFS in early 2020. FS level was measured with the validated USDA 10-item HFSSM. Associations of food insecurity with biographical attributes, food environment, and academic success were determined with Chi-square and Wilcoxon rank sums tests ($p<.05$ = significant).

Results: Of the 1387 eligible respondents (who statistically represented the demographics of the 2020 student body well), 75% were food insecure (52% with very low FS, which is much higher than the general national and provincial levels). Lower levels of FS were significantly associated with gender (males>females), being single, being a first-generation student, and being on financial support. Lower FS level was significantly associated with lower average 2019 end-of-year academic scores. Food insecure students were significantly more likely than their peers to skip breakfast, eat all their meals alone, and not bring a lunchbox to class/work. Lack of time and access to procure ingredients and prepare their own meals, lack of storage and cooking facilities, lack of food procurement and preparation skills, lack of facilities to warm lunchbox food on campus/at workplace, and lack of time and money to buy and eat meals on campus/at workplace.

Conclusion: The institutional organization of its food environment is a driver of levels of food insecurity among students.

Keyword: food security, food environment, students, higher education, academic achievement

PAB(T6)-288

The association of sociodemographic and lifestyle changes with body weight status during COVID-19 pandemic among university students in Shah Alam, Selangor

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Background and objectives: This cross-sectional study was conducted to determine sociodemographic factors and lifestyle changes with body weight status during COVID-19 among university students in Shah Alam, Selangor.

Methods: Respondents (n= 403) completed an online self-administered questionnaire comprising self-reported height and weight, sociodemographic characteristics, and Simple Lifestyle Indicator Questionnaire (SLIQ), which includes questions on diet, physical activity, alcohol intake, smoking and stress level before and during the COVID-19 pandemic.

Results: Most of the respondents were females (59.6%), of Chinese ethnicity (38.7%), with bachelor's degrees (72.2%) qualification. During this study period, most of the respondents were staying at home (77.2%), living with family (81.4%) with a household income of less than RM2500 (43.7%). There was no significant difference in body mass index (BMI) between male and female respondents in this study, either before or during the COVID-19 pandemic, with $p>0.05$. As for BMI differences, the majority (44.7%) had no changes in BMI. However, most respondents (53.8%) were weight gain in body weight changes. Varying total SLIQ scores can be observed across sociodemographic characteristics before and during the pandemic. However, the results were not statistically significant ($p>0.05$). In terms of body weight status and SLIQ scores were reported higher mean SLIQ scores among overweight respondents than in the other BMI categories ($p<0.05$) before the pandemic. A similar trend was observed during the pandemic. However, the result was not statistically significant. Different lifestyle changes can be observed across sociodemographic factors and body weight status, specifically before the pandemic.

Conclusions: Different lifestyle changes can be observed across sociodemographic factors and body weight status, specifically before the pandemic. Findings can be utilized to develop effective intervention strategies which is also crucial in the fight against COVID-19, obesity and other non-communicable diseases

Keyword: Eating habit, Body weight status, University students, Lifestyle , Sociodemographic

PAB(T6)-289

Effects of exclusive breastfeeding for six months compared to four months on growth and infection among Indian Children using the Healthy Birth, Growth & Development Knowledge Integration (HBGDKi) dataverse

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Background and Objectives: World Health Organization recommends exclusive breastfeeding (EBF) for six months, but the proportion of children exclusively breastfed for six months from individual south Indian cohort datasets is between 1-11%. This analysis compared growth (underweight, stunting and wasting) and infections (respiratory and diarrheal) at 12, 18 and 24 months among Indian children exclusively breastfed for four and six months, respectively, using the HBGDKi dataverse.

Methods: Healthy Birth, Growth and Development Knowledge integration (HBGDKi) dataverse integrates 29 datasets of various cohort studies and randomized control trials from India between 1990-2014. Of the 29 studies, 8 with variables in line with the objectives of this analysis were harmonized. The proportion of infants exclusively breastfed for four and six months of age was computed. A one-one propensity score matching was performed for the baseline characteristics to ensure comparability of children between the four and six month exclusively breastfed groups. Linear mixed models were used for comparing the continuous outcomes between the two groups. Generalized linear mixed models were used for binary outcomes to account for multiple repeated measures over time.

Results: Of the 55,263 infants, 2606 (4.7%, 95% CI 4.6%-4.9%) and 1657 (3%, 2.9%-3.1%) infants were exclusively breastfed for four and six months, respectively. Following propensity score matching, 238 children were available for comparison in each of the four- and six-months groups. Children with six months of EBF had better growth at 18 months [LAZ score: -1.53 (1.04) versus -1.97 (1.08)] and 24 months [LAZ score: -1.67 (0.99) versus -2.08 (0.95)] compared to their counterparts with four months of EBF. Further, children exclusively breastfed for six months had a decreased risk of respiratory (RR 0.26 ,95% CI 0.15, 0.45) and diarrhoeal (RR 0.49, 95% CI 0.44, 0.45) infections during the first two years of life, compared to those exclusively breastfed for four months.

Conclusion: Indian children exclusively breastfed for six months had better growth and lower risk of infections compared to those exclusively breastfed for four months. This reiterates the importance of the six-month exclusive breastfeeding practice that needs to be strongly promoted in the Indian setting.

Keyword: Exclusive Breastfeeding, Indian Children, Growth, Infections

Conflict of Interest Disclosure: The findings and conclusions in this abstract are those of the authors and do not necessarily represent the official position of the ICMR- National Institute of Nutrition.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-290

Healthy and sustainable diets in The Gambia: an assessment of deviations from EAT-Lancet recommendations

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Background and objectives: Appropriate dietary change is pivotal for improving population health, increasing food system resilience, and minimizing adverse impacts on the environment. However, there is little research on the sustainability of diets in low-and middle-income settings. Our objective was to assess deviation of the Gambian diet from the EAT-Lancet guidelines for health and sustainability and identify potential areas to improve nutritional and planetary health.

Methods: We performed secondary analyses using the recent Integrated Household Survey dataset with food consumption data from 12,713 households. We assessed deviation from health and sustainability by comparing intake of different food groups against the EAT-Lancet dietary guidelines. We computed a context-specific "sustainable and healthy diet index (SHDI)" based on adherence of different food groups to the EAT-Lancet recommendations and modelled the socio-economic and geographic determinants of households that achieved higher scores on this index, using multivariable mixed effects regression.

Results: There was very low adherence to EAT-Lancet recommendations in The Gambia. The intake of refined grains and added sugars exceeded the recommendations while consumption of important food groups such as fruits, vegetables, dairy, poultry, and beef and lamb were much lower than the EAT-Lancet targets. Higher SHDI scores were associated with female headed households, small household sizes, high wealth index, and residing in an urban settlement. Furthermore, seasonality and crop production diversity played an important role in the diet, with healthier and more sustainable diets reported in the dry season as compared to the rainy season, and increased SHDI score in households with high crop production diversity.

Conclusions: We show that while the Gambian diet is less healthy, it is low in components known to impact most on the environment such as beef, dairy, and pork. Dietary policy to improve on health and sustainability should focus on the substitution of refined grains by wholegrains and reduction in added sugar consumption. Agricultural diversification and poverty reduction are also important factors for improving diet quality and sustainability in The Gambia.

Keyword: Dietary sustainability, EAT-Lancet diet, Diet composition, Environmental footprint

PAB(T6)-291

Dietary diversity does not equal nutritional adequacy in pregnant women in Northern Ghana

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Background: Adequate dietary intake during pregnancy is necessary for optimum pregnancy weight gain and desirable outcomes. Dietary diversity during pregnancy has been promoted as a means of meeting the nutrient needs for foetal growth and development, mother's wellbeing and preparation for lactation.

Objective: We investigated the relationship between the diversity of the mother's diet in pregnancy and their nutrient adequacy among pregnant women in a low socio-economic environment in Northern Ghana.

Methods: In a prospective cohort study, we recruited and followed up 596 pregnant women from their first trimester (10-12 weeks) of pregnancy through to delivery. Three repeat 24-hour dietary recall measurements at recruitment, second trimester and late third trimester were used to ascertain dietary intake and diversity score (DDS). Nutrient adequacy was measured by computing the Nutrient Adequacy Ratio (NAR) and the Mean Adequacy Ratio (MAR). Chi-square test for proportions was used for DDS comparisons. Independent t-test and ANOVA were used for NAR and MAR with a significance level of $p<0.05$.

Results: Nearly 41% of the study participants (40.9%) were observed to consume highly diverse foods (consumption from 5 or more food groups). However, over 80% of total daily energy intake was carbohydrate. Overall, MAR was found to be low although relatively higher among those with higher DDS ($p<0.001$). Of 11 key nutrients in pregnancy studied, except for carbohydrate and ascorbic acid, nutrient adequacy was not met even among participants with higher dietary diversity scores.

Conclusion and recommendation: Among pregnant women in this low-income community, diversifying dietary intake alone may not be sufficient to improve nutrition and enhance pregnancy outcomes. There is a need for nutrition literacy emphasizing portion sizes and food combinations to maximize nutritional benefits.

Keyword: Nutrient adequacy, Dietary diversity, Pregnant women, Low income, Northern Ghana

Conflict of Interest Disclosur: There is no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-292
A comparative analysis of key attributes and performance ratings across prominent food industry assessment tools

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Background and objectives: Large food companies hold substantial power within the global food system and can act as a significant barrier and opportunity to progress on addressing nutrition. In an effort to promote private sector accountability for population and planetary health, several food industry assessment tools have been developed to benchmark companies on their Environmental, Social, and Governance (ESG) performance, including in relation to nutrition. Investors are increasingly using ESG data to inform their decision-making and corporate engagement activities. Given the growing burden of diet-related disease and increasing recognition of business risks and opportunities for addressing nutrition, it is critical to understand the scope of nutrition performance data currently available to investors. This study aimed to compare prominent tools used to assess food companies on their nutrition performance, in order to generate consensus on appropriate metrics for investors.

Methods: A comparative analysis of the type, number and weightings of relevant metrics across five civil society-led food industry assessment tools and a commercially-available ESG dataset was conducted (2021). Data on the nutrition-specific and overall ESG performance ratings of 25 major global food and beverage manufacturers were extracted and compared across three of these initiatives, with companies assigned a performance rating of 'low' (score = 0-25% or D), 'moderately low' (25-50% or C), 'moderately high' (50-75% or B) and 'high' (75-100% or A).

Results: Methodologies across the six tools were not standardised, with substantial variation in the number of indicators and the weightings assigned to assessment criteria. However, tools were largely found to assess similar nutrition-relevant topics, including 'product healthfulness', 'product marketing and labelling', 'product distribution and equity' and 'corporate governance'. Despite methodological differences, when three initiatives were applied in practice to assess 25 major global food and beverage manufacturers, companies were found to perform relatively poorly on nutrition-specific and overall ESG metrics across all initiatives (median score = 'moderately low'). No companies across any of the tools received a performance rating of 'high'.

Conclusions: Harmonization and prioritization of metrics across existing food industry assessment tools is necessary to drive uniform and consistent use of nutrition-related ESG data in financial markets.

Keyword: ESG, Sustainable investment, Accountability, Food company, Nutrition

Conflict of Interest Disclosure: Dr. Mozaffarian reports research funding from the National Institutes of Health, the Gates Foundation, The Rockefeller Foundation, Vail Innovative Global Research, and Kaiser Permanente; personal fees from Acasti Pharma, Barilla, Danone, and Motif FoodWorks; scientific advisory board, Beren Therapeutics, Brightseed, Calibrate, Discern Dx, Elysium Health, Filtricine, HumanCo, January Inc., Perfect Day, Tiny Organics, and (ended) Day Two and Season Health; stock ownership in Calibrate and HumanCo; and chapter royalties from UpToDate.

The other authors do not have any conflicts to interests to declare.

PAB(T6)-293
Consumption of legumes in two seasons of the year during the COVID-19 pandemic in Chile

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Background and objectives: In Latin America, the number of studies that have investigated the consumption of legumes during the pandemic is limited. The objective of the present study is to describe the intake of legumes in 2 different seasonal periods, during the COVID-19 Pandemic in Chile.

Methods: Serial cross-sectional study surveys were distributed during the summer and winter seasons using different digital platforms and social networks. We investigated the frequency of consumption, access to purchase any type of preparations. **Results:** A total of 3,280 adults in summer and 3,339 in winter, mean age 33 years. 97.7 and 97.5% of the population indicate consuming legumes in both periods, with consumption increasing in the group of 3 times a week in winter. In both periods, the main preference for consumption is that they are rich and nutritious, followed by the fact that they replace meat and that they are profitable, the main barrier for their non-consumption in both periods is that they are expensive (29% in summer and 27.8% in winter) and are difficult to prepare (12.1% in summer and 11.6% in winter). The main form of preparation is in traditional stews and salads. Although the supermarket is the preferred place, the purchase changes according to the season, sales increase during the winter in supermarkets, online purchases, but decrease in free fairs and neighborhood stores. 35% indicate that they know the recommendations of the food guides on legumes and the most recognized property "they are rich in protein and provide fiber".

Conclusions: During the pandemic there is a good consumption of legumes, seasonal differences in consumption are observed, since there is a greater frequency of consumption in winter, considering greater than or equal 3 time a day, we also found differences in purchases according to seasonality, but not in the form of preparation, on the other hand among the factors that favor consumption is that they are rich and nutritious, change among the factors that hinder consumption is that they are expensive and difficult to prepare.

Keyword: legumes, intake , Chilean, COVID-19

PAB(T6)-294
Nutrient Intakes Among 0.5 – 11.9-year-old Children in Vietnam in 2020

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Background and Objectives: Vietnam, as a new developing country, has undergone a period of rapid change over a few decades. As a result, the country's population has experienced remarkable transition of diet from relatively poor rations toward foods richer in animal proteins, lipids, and processed products. The Vietnamese South East Asian Nutrition Survey II (SEANUTS II Vietnam) was conducted in 2020 in alignment with SEANUTS I from 2010/2011 to assess the nutritional status together with dietary pattern of children aged 0.5-11.9 years. The up-to-date information obtained can serve as inputs for country policy and development of nutrition programs.

Methods: SEANUTS II Vietnam is a cross-sectional study conducted in six representative regions of the country. Dietary intake was assessed using one-day 24 hours dietary recall and food diary. The data was converted into nutrient intakes with the Nutrisoft program developed by the National Institute of Nutrition, using the Vietnamese food composition table, and compared to Vietnamese Estimated Average Requirement (EARs) and Recommended Nutrient Intakes (RDAs).

Results: In total, 3904 children between 0.5-11.9 years old were included in the analysis. In general, boys and urban children consumed higher amounts of macro- and micronutrients than girls and rural children respectively. The differences were more prominent in the older children.

Overall, 75% of the children did not meet the estimated energy requirements and this percentage was higher in the older children (84%) compared to the younger children (59%). For calcium, ~60% of the younger children did not meet the RDA while it was 93% in the oldest children. For Vit D, >84% of the children did not meet RDA irrespective of age.

Conclusions: The data suggest that further efforts must be undertaken to ensure that children in Vietnam receive adequate nutrients for a healthy growth and development.

Keyword: nutrient intake, SEANUTS, children survey

PAB(T6)-295
Establishing online dietary assessment models to facilitate strategies for reducing sugar intake

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Obesity is a major challenge to global public health. According to "Taiwan Nutrition and Health Status Change Survey 2013-2016" showed that the prevalence of adult overweight and obesity reached 45.4%. Poor dietary quality could lead to lots of metabolic diseases. Excessive intake of sugary foods leads to an increased risk of obesity and its derived chronic diseases. However, an increase in the intake of sugary foods will result in an increase in total calories consumed and a decrease in the intake of other essential nutrients. The World Health Organization published the "Guidelines on Sugar Intake for Adults and Children" in 2015. It is recommended that the intake of free sugars in the diet should be kept below 10% of the total daily caloric intake, which can reduce the incidence of overweight, obesity and tooth decay. Therefore, the trend of sugar reduction has been attached great importance. More and more commercial products use sugar substitute, due to their low cost and sweeter taste. First, we conduct the systematic review and network meta-analysis to evaluate the effect of low-calorie sweeteners (LCS) on weight management. Second, establish an online dietary database, combined Taiwan, United States, Japan and Vietnam database. To collect different group of their dietary records used to analyze the daily sugar consumption. Third, design an interventional experiment, using design thinking model to create an active sugar reduction plan. The experimental design has a total of four weeks of experience. The online social network platform is equipped with AI chatbot interactive technology. It interacts with participants daily to set tasks challenge, reflect on the body's feelings and daily health hazards of taking too much refined sugar, and then increase the motivation to reduce sugar. Integrate online sugar reduction education to effectively establish healthy literacy concepts, improve physical health, achieve a healthy lifestyle of sugar reduction program!

Keyword: Sugar Reduction, weight management, dietary assessment

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-296

Agricultural production diversity, dietary intake, and child nutritional status: Evidence from clustered longitudinal study in rural Ethiopia

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Background: Infants and young children have low access to a diversified diet in low- and middle-income countries. Diversified diet predicts the adequacy in macro-and micro-nutrients to cover the child increasing nutrient requirements for their growth and development. Integrating agriculture into the framework of interventions targeting undernutrition reduction has been promoted. Evidence on the contribution of nutrition-sensitive interventions to dietary diversity at the household and the individual levels, and children's nutrition status is limited.

Objective: To assess the association between agricultural production diversity, household dietary diversity, and the nutritional status of 0-59 months aged children in Ethiopia.

Method: Using a cluster trial design, rural communities in four agricultural regions in Ethiopia were assigned to receive the Sustainable Undernutrition Reduction in Ethiopia (SURE) program intervention or to non-intervention between 2016 and 2021. The program intervention package includes promoting diversified agriculture, infant and young child feeding and water, sanitation, and hygiene practices. At baseline, children who were 0-23 months of age were assessed for their weight, height, and hemoglobin concentrations. Dietary and agriculture production data were collected using a structured questionnaire. The same assessments were carried out after four years of intervention, on the same children who were 48-59 months of age. Length/Height-for-age, weight-for-age, and weight-for-length/height Z-scores were calculated based on 2006 World Health Organization standards. Food production diversity was regrouped to fall in line with the recommended seven food groups used in defining dietary diversity scores in children. Bivariate and multivariate regression models were used to determine the association of production diversity and children's nutritional status.

Result: Totally 1289 participants included. At baseline, 44.1 %, 18.6%, and 2.5 % of infants and children were stunted, underweight, or wasted, respectively. The mean adjusted hemoglobin concentrations (mean ± SD) in children were respectively 10.2 ±1.48 g/dl and 11.9 ± 1.3 g/dl at baseline and endline. Prevalence of anemia decreased from 69.3% to 22.1% (P=0.01). Household dietary diversity score has a significant association with child dietary diversity score, stunting and hemoglobin concentration (P<0.001).

Conclusions: Producing a variety of foods at the household level was positively associated with child dietary diversity score and hemoglobin status.

Conflict of Interest Disclosure: No conflict of interest

PAB(T6)-297

Plant-based meat alternatives can help to lower the dietary animal to plant protein ratio

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Background and objectives: For personal and planetary health reasons, recommendations are to consume more plant protein. Developed countries consume ~2-fold protein from animals than plants. The optimal animal to plant protein ratio has not been determined; however, the 2:1 ratio in developed countries is generally recognized as being too high. The Eat Lancet Commission recommends obtaining most protein from plants whereas the Dutch Dietary Guidelines recommend a 1:1 animal to plant protein ratio. Even meeting the Dutch recommendation will be challenging because of the culinary and cultural role meat plays in many societies.

Methods: One approach to lowering the animal to plant ratio is to rely more on legumes. These protein- and fiber-rich foods are underutilized in most areas of the world. Globally, only 6% of protein is derived from pulses (a type of legume). However, despite their many accolades and public health efforts to promote their consumption, there is little evidence to suggest legume intake will substantially increase in the near future.

Results: An alternative to consuming legumes is to consume plant-based meat alternatives (PBMAs) made from concentrated sources of legume protein such as soy and pea. Research indicates that for PBMAs to be embraced by consumers, they need to mimic the taste, texture, visual appearance, and cooking method of meat. The new generation of PBMAs meets those criteria. Not only is their environmental footprint lower, but research shows that when compared to their animal product counterparts, PBMAs favorably affect several chronic disease risk factors, help reduce body weight and favorably affect the gut microbiome. A potential obstacle to greater PBMA intake is their classification by NOVA as ultra-processed foods (UPFs). However, recent research shows that none of the common criticisms attributed to UPFs apply to soy-based meat alternatives more than they do to beef, which is classified by NOVA as unprocessed or minimally processed. Additionally, many PBMAs are rated highly by other nutrient profiling models.

Conclusions: NOVA does a disservice to consumers by classifying PBMAs as UPFs as they represent a convenient, nutritious, and environmentally friendly option for lowering the animal to plant protein ratio in developed countries.

Keyword: NOVA, Legumes, Soy, Processing, Plant-based meat alternatives

Conflict of Interest Disclosure: The author is employed by the Soy Nutrition Institute Global which receives funding from US soybean farmers via the national soybean checkoff program and via membership dues from companies involved in the soy industry

PAB(T6)-298

Intervention of whole grain education program improves knowledge, attitude, and behaviors toward whole grains intake among community-dwelling elderly

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Background and objectives: According to Health Promotion Administration, Ministry of Health and Welfare's recommendation, at least 1/3 of daily grains intake should be whole grains (WG). This study aimed to evaluate the influence of the WG education program for community-dwelling elderly on knowledge, attitude, and behavioral changes.

Methods: This program included three sessions: (1) to identify the difference between WG and refined grains, and understand the benefits of WG and how to prepare good-tasting WG; (2) to know where to buy and how to choose WG; and (3) to know how to preserve WG. Knowledge changes were evaluated before and after the course at each session with four questions. All participants completed the questionnaire at pre- and post-program intervals to evaluate attitude change about eating WG, while behavioral change was evaluated as the frequency and quantity of WG intake.

Results: Ninety-six participants were included with average age of 74.7±7.2 years with 50% being over 75 years; average BMI was 23.9±3.1 kg/m^2; and 25.0% lived alone. At commencement, the average score of differentiating WG and refined grains was 9.6±4.1, and this had increased to 14.7±2.4 (p<0.001) after the course. The scores of "to point out the benefits of WG" were 5.6±2.0 and 6.8±0.7 pre- and post-program separately (p<0.001). Knowledge changes concerning WG were significantly increased after each session (1.8±1.2/3.7±0.6, 3.2±0.8/4.0±0.1 and 3.1±0.9/3.8±0.5 for pre-/post-session at sessions 1, 2 and 3 separately, p<0.001). "The willingness toward eating WG at least 1/3 of daily grain intake" was 7.1±3.0 pre-program increasing to 7.9±2.7 post-program (p<0.01). "The confidence toward eating WG at least 1/3 of daily grain intake" was 5.6±3.4 and 7.7±2.8 pre- and post-program separately (p<0.001). Frequencies of WG intake at breakfast, lunch and dinner all increased significantly post-program (p<0.001); besides, the quantity of initial daily intake of WG averaged 2.0±2.8 Ex increasing to 4.7±3.9 Ex after program administration (p<0.001).

Conclusions: A series of a WG education program could improve the knowledge of WG choosing, purchasing, and storage; strengthen the confidence and attitude toward eating more WG; and finally transfer to the daily practice of eating more WG.

Keyword: whole grain education program, community-dwelling elderly, knowledge, attitude, behavior

PAB(T6)-299

The role of fish in biodiverse patterns of household food expenditure and its socioeconomic determinants in Ghana

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Background and objectives Fish is an important component of African diets; however, there are socioeconomic differences in its contribution to health and nutrition. In lower socioeconomic settings, fish is a nutrient-dense animal source food that supports maternal and child nutrition. In higher socioeconomic settings, fish consumption with whole grains, fruits, and vegetables is protective against overnutrition outcomes. Furthermore, fish is a loosely defined food group that can include many types of biodiverse marine and freshwater fish or shellfish with variable prices or nutrient composition. The objectives of this study were to assess patterns of food expenditure among Ghanaian households, their socioeconomic determinants, and whether they were sensitive to disaggregating fish into biodiverse food groups.

Methods The analysis used nationally representative cross-sectional data collected from 13,944 households as part of the seventh round of the Ghana Living Standards Survey. We used a principal component analysis (PCA) to identify patterns in food expenditure, then stepwise multivariate regression analysis to assess relationships between each pattern and a range of socioeconomic variables. In a sensitivity analysis, we disaggregated fish into food groups that reflect its ecosystem origin (marine or freshwater) or genera/species (mackerel, herring, or tilapia) and repeated the PCA and stepwise regression.

Results: We found three dominant patterns of food expenditure that align with the nutrition transition: a 'Plants and fish' pattern of starchy staples, fruits, vegetables, and fish; 'Processed foods' included refined grains, processed meats, dairy, and sweets; and 'Food away from home' (FAFH) included meals prepared in restaurants. In general, the 'Plants and fish' pattern was tied to low socioeconomic status and the 'Processed foods' and 'FAFH' patterns to high socioeconomic status. Disaggregating fish did not change the composition of the three patterns nor their relationships with socioeconomic determinants, though it revealed that two types of freshwater fishes were correlated in the 'Plants and fish' pattern and two types of marine fishes in 'Processed foods'.

Conclusions Incorporating biodiversity principles into food and nutrition research may reveal important nuances in fisheries-food systems where many types of fishes are produced and consumed as part of a nutrition transition.

Keyword: Fish, Biodiversity, Household consumption and expenditure surveys, Ghana

Conflict of Interest Disclosure: The authors report no conflicts of interest.

PAB(T6)-300

Predictors for weight retention and barriers for weight management in postpartum women: A cross-sectional study.

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Background and objectives: To study the association of postpartum weight retention with socio-demographic, obstetrics and lifestyle-related factors. To investigate barriers/myths associated with postpartum weight management.

Methods: A hospital-based telephonic cross-sectional survey was carried out using a pre-developed and validated questionnaire to assess the predictors of weight retention and barriers associated with weight management. Convenience sampling technique was employed to recruit women from different phases of the postpartum period i.e. women in the first three months post-delivery, four to six months post-delivery and beyond six months post-delivery. Chi-square test and regression analysis were applied to assess the association of various factors with weight retention/weight gain in different postpartum phases.

Results: The final sample comprised 505 postpartum women with a mean age of 29±4 years. Among socio-demographic variables, socio-economic status was associated with weight retention during the first three months post-delivery ($p<0.05$) whereas type of family and education qualification were associated with weight retention during four to six months post-delivery ($p<0.05$). Among obstetrics correlates, gestational weight gain was associated with weight retention in all three phases of the postpartum period ($p<0.05$). Among lifestyle-related factors, 50.7% of women did not consume regular meals and around 70% women had lower consumption of fruits and vegetables with a higher intake of HFSS foods. Only 5% indulged in low to moderate intensity physical activity whereas 95% had more than 4-hour exposure to screen time and sedentariness. Barriers such as lack of knowledge about diet and physical activity, lack of time, boundation to abide by family's advice and myths such as eating for two, consumption of high-calorie diet and energy-dense galactagogues restricted participants from adopting healthy lifestyle practices.

Conclusions: The study findings will assist in formulating and implementing weight management strategies for postpartum women. Future longitudinal studies must be carried out for further understanding of predictors of postpartum weight retention.

Keyword: Postpartum weight retention, Predictors, Barriers, Weight management, India

Conflict of Interest Disclosure: There is no conflict of interest to be disclosed.

Further Collaborators: No

PAB(T6)-301

Current situation of nutritional pattern and body weight of mining workers

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Background: The objectives of this research work were to determine the current dietary condition and reality of implementing a program aimed at improving the nutritional status of mining workers in accordance with improving health indicators such as decreasing obesity rate. The level of obesity in Mongolia has been increasing dramatically over the years, and that it is likely to be higher than the national average among mine workers.

Method A total of 300 mining workers, aged 20-63 were collected. Dietary study was used FFQ and 24 recall method and total diet energy intake was calculated by the using food composition data. Obesity rates were measured using Inbody370.

Results The average energy intake was 2530±251 kcal and the consumption of dietary protein was high and the consumption of carbohydrates was less than the RDA. Comparing to recommended dietary allowance, energy and fat intake were adequate, protein intake was 1.4-2.2 times higher than the recommended amount. The average body mass index of the miners was 29.2±2.8 kg/m^2, there was no difference between men and women. According to the results of the survey, the percentage of people with a normal weight is 27%, and the percentage of overweight and obesity is 73%. In our country, the prevalence of overweight and obesity is common among the population aged 15-49 and has increased from the level of the 2010 IV nutrition survey. Mining workers overweight and obesity level is higher than the national level. It is necessary to pay attention to the fact that the prevalence of severe obesity is 7.6%.

Conclusion The daily calorie intake is not high, but the level of obesity has become too high, it is necessary to continue to carefully study and improve the nutritional knowledge related to balanced diet of the mining workers in further.

Keyword: daily intake, mining workers, obesity, nutritional knowledge

Conflict of Interest Disclosure: no

Further Collaborators: no

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-302

Current status of self-efficacy and food environment regarding fruit intake among working generations

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Background and objectives: The recommended average daily fruit intake for the Japanese is 200 g (two servings; SV), but the actual intake of working generations does not meet 100g (one SV) per day. Therefore, to promote fruit intake, we conducted a questionnaire survey targeting working generations with low fruit consumption. In this study, we analysed the participants' recognition of fruit intake and the current state of the food environment.

Methods: In 2020, we conducted a questionnaire survey targeting approximately 400 employees of a certain company in Mie Prefecture. We distributed 357 questionnaires and obtained 346 responses (response rate of 96.9%). The analysis items included fruit intake recognition (self-efficacy/outcome expectancy), food environment (food access/family consumption behaviour), purchasers, and purchase locations. All statistical analyses were performed with IBM SPSS Statistics Version 26.

Results: Of the participants, 92.8% were men, and individuals in their 50s (36.7%) and 20s (23.7%) constituted the highest percentage of respondents, followed by individuals in their 30s (19.7%), 40s (10.5%), and > 60s (7.2%). While 43.4% of the respondents acknowledged that fruit intake prevents lifestyle-related diseases, only 6.4% answered that they were “extremely confident” about consuming fruits every day. Additionally, majority of the purchasers were “family members” (73.0%), of whom only 16.8% ate fruits “almost every day”.

Conclusions: Self-efficacy for daily fruit intake was low despite high expectations for fruit intake results; therefore, devices or supports to increase self-confidence in fruit intake are needed. Moreover, we confirmed that the fruit intake frequency of family members, who are the main purchasers, is extremely low. It is crucial to strengthen dietary education involving not only working generations with low fruit intake but also their family members.

Keyword: Fruit intake, Working generation, Self-efficacy, Food environment

PAB(T6)-303

Nutrition International's efforts in strengthening capacity of medium- and small-scale salt processors to achieve universal salt iodization in Asia: Experiences from Bangladesh, India, Indonesia, and Pakistan

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Background and objectives: Salt is fortified with an ‘essential' mineral iodine, which is crucial for healthy brain development; and prevention of goitre, reduced intellectual and motor performance, cretinism, brain damage, stillbirth, and miscarriage. Universal Salt Iodization (USI) is described as iodization of all salt for human and livestock consumption; and helps in improving iodine intake levels of the population and preventing iodine deficiency disorders (IDD). Around 126 countries globally and 35 Asian countries have mandated fortification of salt. In Asia, Nutrition International (NI) is supporting USI in four countries namely, Bangladesh, India, Indonesia, and Pakistan.

Methods: NI works on the following aspects in the salt sector: creation of an enabling environment by supporting improvement of policy and programmes at national and sub-national level to address IDD; and provision of support to salt processors and government officials to ensure improved quality and production of adequately iodized salt. Majority of salt in the listed countries is produced by small and medium-scale salt processors (SMSPs). Use of non-mechanized and rudimentary iodization techniques by SMSPs and lack of effective enforcement of edible salt standards results in production of considerable proportion of inadequately iodized salt. NI provides critical technical and financial assistance to the SMSPs to enable production and sale of adequately iodized salt.

Results: Under NI's “cost sharing model/ pull finance model”, partial cost (25%) of the centrifuge/ dewatering device provided to medium-scale salt processors (SPs) is reimbursed as per the terms in the cost sharing agreement. This helps in mainstreaming edible salt value chain and ensuring better compliance of the edible salt standard. NI supports small-scale SPs by consolidating them and turning them into suppliers of raw salt for medium and large-scale SPs; and/ or packagers of iodized salt produced by large-scale SPs. Additionally, NI undertakes supportive supervision and rigorous monitoring of the SMSPs.

Conclusions: NI's continued efforts in supporting the salt industry have helped in supporting 1,589 SPs, producing 942,300 MTs of adequately iodized salt and reaching an additional 337 million people in Bangladesh, India, Indonesia, and Pakistan in 2022.

Keyword: Universal Salt Iodization, Asia, Iodine, Salt Sector, Small and medium scale salt processors

Conflict of Interest Disclosure: There is no conflict of interest

Further Collaborators: Not applicable

PAB(T6)-304

Twenty-year trends in consumption of main meals and snacks from ultra-processed foods among Korean adults from 1998 to 2018

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Background and objectives: Unfavorable changes in eating patterns over time may contribute to upward trends in chronic diseases such as obesity. We examined 20-year trends in the percentage of energy from main meals and snacks, and the food sources of snacks among Korean adults.

Methods: This study used nationally representative data from the 1st, 4th, and 7th Korea National Health and Nutrition Examination Survey (1998, 2007-2009, and 2016-2018) among adults aged 20–69 years (n=29,389). Each eating occasion (breakfast, lunch, dinner, and snacks) was defined as respondents specified during a 24-hour dietary recall interview. To identify major sources of snacks, we used NOVA system. The percentage of energy from each eating occasion and that from ultra-processed foods(UPFs) in snaking across survey cycle were estimated and tests for linear trends were conducted using orthogonal polynomial contrasts in linear regression models. All analyses accounted for the complex survey design.

Results: Between 1998 and 2018, after adjusting for age and sex, the percentage of energy from breakfast decreased from 25.0% to 16.7% (difference, -8.2%, (95% CI, -8.9% to -7.6%)), whereas percentages of energy from dinner and snacks increased from 31.1% to 33.8% (difference, 2.7%, (95% CI, 2.0% to 3.4%)) and from 14.0% to 19.0% (difference, 5.0%, (95% CI, 4.1% to 5.9%)), respectively (all P < .001 for trend). When stratified by age, 30-39 years old had the largest change in percentages of energy from three main meals. Although we observed the largest increase among older adults (≧50 years), the youngest (20-29 years) consumed the largest energy from snacks. For snaking, from 1998 to 2018, the overall percentage of energy from UPFs increased from 22.9% to 58.4% (difference, 35.5%, (95% CI, 33.7% to 37.4%)) and a greater increase was observed among younger adults than older adults.

Conclusions: The eating patterns of Korean adults have changed from 1998 to 2018, with the greatest decrease in breakfast consumption and the greatest increase in snacking. UPFs have become a major source of energy from snaking, especially among younger adults.

Keyword: Eating behavior, Snacking, Trend, Ultra-processed foods, Korea National Health and Nutrition Examination Survey

Conflict of Interest Disclosure: Conflict of interest disclosure: None.

PAB(T6)-305

Association between Diet Quality and Stunting among Primary School Children in Mbita District, Western Kenya; A Cross-Sectional Study

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Background and objectives: A healthy diets is critical for better health and growth. Diet quality included variety and adequate intake had been rarely investigated in the developing regions of Africa. This study aimed to examine the relationship between diet quality and stunting among school-aged children in western Kenya.

Methods: This study included 237 fourth-grade school children (9-17 years old) in Mbita district, western Kenya. Anthropometric measurements and parasitic infection (malaria and schistosoma monsoni) test were conducted to assess their nutritional status. Child's age, sex and household socioeconomic status (SES) were surveyed. Food intake data were estimated using a food frequency questionnaire developed specifically for this population and evaluated based on the adherence to the recommendation of Kenyan food pyramid dietary guideline (FP). The FP score consists of the five food groups (staple foods, protein-rich foods, dairy products, vegetables, and fruits). If the number of servings consumed is within the recommended serving range, 10 points are added. If outside the recommended range, a lesser number of points will be assigned. The FP score was examined for trend associations with characteristics of participants, nutritional status and energy and food intakes. Logistic regression analysis was performed to examine the risk factors for stunting, with the outcome being stunting and explanatory variables being age, sex, SES, parasitic infection and FP score. Statistical analyses were performed using the IBM SPSS Statistics ver. 28.

Results: Of the school children studied, 13.9% were stunted. FP score ranged widely between 10 and 43 out of 50 points. Higher FP score indicated higher energy and dairy products, pulses and fruits, and were negatively associated with the stunting (adjusted odds ratio = 0.93 [95% confidence interval: 0.88-0.99]). Male and older age children tended to be associated with stunting, although not statistically significant.

Conclusion: Male, older age child and poor diets tended to be associated with stunting. Support for more vulnerable children and encouragement of adequate energy and balanced diets are required.

Keyword: Primary school children, Kenyan Food pyramid score, dietary diversity, dietary habit, dietary guideline

Conflict of Interest Disclosure: There is no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-306
Association between personality questionnaire and eating pattern revealed by a food-log App data.

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Background and Purpose: Advances in technology have made it easy to precisely record an individual's varied nutritional intake status. Using this technique, we investigated the relationship using 27 different nutritional intake data for each meal (breakfast, lunch, and dinner) and personality.

Method: In collaboration with the dietary management application "Asken," a questionnaire survey of approximately 50 items including “Big5” was conducted on 4,174 members residing in Japan. Asken users answered several questionnaires including age, weight, sleep duration, exercise intensity and frequency, and personality score (TIPI-J), and collected nutrition intake records for approximately one month through the app function. Based on those data, we performed correlation and multiple regression analysis.

Result: Those who were more conscientiousness had lower BMI and body fat percentage, exercised more often, ate breakfast earlier, and tended to sleep and wake up earlier. Both men and women with more conscientiousness had higher iron and zinc intake at breakfast and lower carbohydrate intake at dinner. Women also consumed more dietary fiber and minerals such as magnesium and folic acid at breakfast. Their qualities of sleep were better and had a higher sense of health and happiness Open-minded individuals also had higher total daily physical activity (METs), but there were no significant differences in BMI or body fat percentage, and in women, sleep time were shorter.

Conclusion: High conscientiousness individuals have higher exercise habits, sleep quality, and subjective wellness. Highly open-minded individuals have higher levels of well-being, but there are no significant differences in BMI or health. Those results suggest that the personality is somehow correlated to the daily eating pattern, and the personalized nutritional intervention should be considered in the understanding individual personality in the future. This work was supported by JST Mirai Program Grant Number JMPJM120D5.

Keyword: Chrono-nutrition, Nutrition intake, Personality

Conflict of Interest Disclosure: Data collection was conducted by asken Inc.

PAB(T6)-307
The role of diet on seasonal variations in growth in children under 5 years in rural India

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Background & Objective India has a high burden of undernutrition and the national surveys have demonstrated that there are seasonal variations in the prevalence of undernutrition in children under 5 years, particularly in the prevalence of wasting. The impact of morbidity and labour demands on this seasonal effect is documented. It is expected that variations in dietary intake would also impact the seasonality. This longitudinal study examines the role of consumption of different foods on weight standardized for age and height of children aged 12-60m in Bihar state of India. **Methods** Anthropometry and 24-hr diet recall data were collected from rural children residing in 1732 households in two major cropping seasons, monsoon and winter. Additional data on socio-demographic characteristics was also collected. Age and sex specific standardized weight and height (HAZ, WAZ and WHZ) of children were computed. The dietary intake of cereals, legumes, fats & oils, added sugar, fruits and milk in gms per day was computed. The consumption of food groups was regressed on age of the child in round 1 and the estimated equation was used to predict the consumption of each child in round 2 based on its age. The difference from the expected consumption was consumption of the food groups was considered as a dependent variable in multiple linear regression of standardized weight and height scores in round 2. **Results** There mean WHZ improved from -1.11(1.52) to -0.42(1.07) from monsoon to winter seasons reflecting in a 16% point reduction in wasting (WHZ<-2). There was an improvement in WAZ but not in HAZ. Milk consumption in children improved from round 1 to 2in the lower quintiles of consumption. Increase in milk intake improved all anthropometric measures (WHZ (Beta= 0.001, 95% CI: [0.0002, 0.001]), WAZ (Beta= 0.001, 95% CI: [0.001, 0.003]) and HAZ (Beta= 0.0014, 95% CI: [0.001, 0.002])) and that of fruits improved WAZ (Beta= 0.002, 95% CI: [0.0001, 0.003]). **Conclusion** Increased consumption of milk and fruits in the winter season compared to monsoon can improve WAZ of children aged 12-60m.

Keyword: Seasonality, Undernutrition, Children

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T6)-308

Plant-based diets and metabolic status in children: vegan and vegetarian diets may predispose to anemia and protect from high cholesterol

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Background and objectives: The diets of children in the Western world are shifting towards more plant-based, yet barely any studies have been conducted on the metabolic effects of fully or almost fully vegan diets in children. In the MIRA Helsinki (2017) and MIRA2 (2022) cross-sectional studies, we aimed to fill this gap in knowledge by investigating the nutritional and metabolic effects of vegan and vegetarian diets in children.

Methods: We collected 3- to 4-day food records and blood and urine samples from 54, 26, and 33 children who followed an omnivore, vegetarian and vegan diet, respectively. The children were recruited from day care centers in Helsinki and were of 1-7 years of age. A targeted set of clinical laboratory tests from the biological samples were conducted to assess the nutritional status of the participants. Serum amino acids were analyzed only for the latter (28 omnivore, 16 vegetarian and 27 vegan diet), and erythrocyte folate for the former study (26 omnivore, 10 vegetarian and 6 vegan diet).

Results: Supplementation guidelines for vitamin D (> 7.5 µg/day) were met by 82%, 85% and 100% of children on omnivore, vegetarian and vegan diet, respectively. Vitamin B12, iodine and EPA+DHA supplements were used by 31 (94%), 31 (94%) and 4 (12%) vegans, respectively. The vegan diet group had significantly lower serum/plasma concentrations of LDL cholesterol and essential/non-essential amino acid ratio, and significantly higher erythrocyte folate and plasma triglyceride concentration than omnivore group. The vegetarian diet group showed average concentrations between the omnivore and vegan diet groups. One (2%), three (12%), and four (12%) children on an omnivore, vegetarian, and vegan diet had mild normocytic anemia (Hb < 112 g/L). Two non-anemic children on vegan diet had potential vitamin B12 deficiency (Transcobalamin-bound B12 < 70 pmol/L). 12 (22%) omnivores, no vegetarians and 2 (6%) vegans had hypercholesterolemia (LDL > 3 mmol/L).

Conclusions: Planning an adequate vegan diet for children is complex and requires thorough understanding based on sufficient research with child participants. Special attention may be required to ensure adequate erythropoiesis and use of diverse sources of proteins to provide all essential amino acids.

Keyword: vegan, children, cholesterol, amino acids, anemia

Conflict of Interest Disclosure: LK was a board member of the company TwoDads at the time of the MIRA Helsinki study. MaE and LK disclose author's fee from Finnish Medical Journal Duodecim. AS has obtained speaker fees from Orion Pharma and is part of Khondrion SAB, unrelated to this study.

Further Collaborators: Minnamari Edelmann (University of Helsinki, Finland), Jürgen Erhardt (VitMinLab, Germany), Kevin Cashman (University College Cork, Ireland)

PAB(T6)-309

Food insecurity and changes in food consumption during the Covid19 pandemic in Brunei Darussalam: a cross sectional study

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Background and objectives: The COVID-19 pandemic has affected the economy, social, emotional wellbeing and dietary behaviours. Due to movement restrictions and anxiety of the Covid-19 infection; takeaway foods, more frequent snacking and less physical activity became normalised. It was deemed critical to investigate the changes in dietary practices and child food security. Remote method of data collection support adherence to the low contact guidance.

Methods: Contact numbers were retrieved randomly from the health information systems database. Eligible respondents (caregivers of children between 2 to 14 years and adolescents aged 15 to 19 years) were invited to answer a 10 minute online survey adapted from standardized indicators to collect nutrition data. Food Insecurity Experience Scale (FIES) calculations was conducted through the Food Agriculture Organisation's Voices of the Hungry (VoH) website. Targeting through notifications on the Bruhealth, the mobile health application, the cross sectional survey was carried out from June to August 2022.

Results: 459 caregivers (98% female) and 60 adolescents (70% female) responded. It was found 25.7% (n=118) of children aged 2-18 years with reported decreased consumption of one or more healthy food groups (out of 13) due to Covid-19. A mean of 5.1 (standard deviation 3.6) food groups (out of 13) with reported decreased consumption by child aged 2-18 years. Of note, 27.2% (n= 125) of caregivers reported Meats food group with reported decreased consumption. 16.1% of caregivers of children aged 2-18 years report moderate and 12.8% severe household food insecurity according to the Food Insecurity Experience Scale (FIES). According to the Child Food Insecurity Experience Scale, 40% of adolescents aged 15-18 years reported many food insecurity experiences (n=24).

Conclusions: This study quantified the food insecurity experience and the changes of food consumption among children aged 2-18 years. The use of innovative method to collect information on caregiver and adolescent experiences during a period when household surveys were not recommended, may provide guidance for wider use. Further analysis is required to assess whether government initiatives lessen the impact of Covid-19 on households.

Keyword: Dietary behaviors, COVID-19, food insecurity, adolescents, child

Conflict of Interest Disclosure: Chan Si Yee, Sattha Engpornsin, Sharleen Othman, Yuan Wei and Lim Hong Shen are full-time employees of EVYD Technology Limited which was the technology partner and research collaborator of this study. EVYD Technology Limited is the developer of BruHealth Mobile

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Application and Content Management System platforms. The authors declare that there are no other conflict of interest

Conflict of Interest Disclosure: This research was supported by Health Canada. In 2018, Ms. Pauzé received a small honorarium from the Stop Marketing to Kids Coalition for reviewing their policy recommendations and supporting evidence.

Keyword: Food environment, Adolescents, Food advertising expenditures, Canada, Media

Further Collaborators: Adena Pinto and Meghan Pritchard

PAB(T6)-310
How much does the food industry spend on advertising food and beverage products heavily advertised on youth-appealing television stations in Canada?

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Background and Objectives: Exposure to unhealthy food marketing is likely promoting poor eating habits and obesity among Canadian adolescents. The purpose of this study was to quantify advertising expenditures on food and beverage products frequently advertised to adolescents in Canada and assess how much is spent advertising less healthy products.

Methods: Advertising expenditure estimates for 57 select food categories for January to December 2019 were licenced from Numerator. This company estimates advertising expenditures for five media (television, out-of-home, radio, print and digital) using advertising, audience measurement and/or billing data that it collects itself or that is provided by other companies (e.g., broadcasters). Sixty-one food and beverage products or brands identified as frequently advertised on two youth-appealing television channels using television advertising data were included in the study. The nutritional information of these products was collected, and their healthfulness was assessed based on their content in sodium, sugar, and saturated fat using a nutrient profiling model (NPM) proposed by Health Canada. This NPM classifies products as "would be" or "would not be subject to food advertising restrictions". The distribution of advertising expenditures by media, food category and NPM classification were tabulated.

Results: In 2019, about $111 million was spent advertising the 61 food and beverage products or brands heavily advertised on youth-appealing television stations. Television accounted for 77% of this spending, followed by out-of-home media (7.6%), radio (7.5%) and digital media (7.4%). The top three food categories accounting for the largest share of these expenditures were fast food (51%), soft drinks (12%), and milk and dairy alternatives (9.7%). More than two-thirds (77%) of this spending were allocated to products classified as "would be subject to restrictions".

Conclusion: The food industry is spending millions to promote unhealthy food and beverages heavily advertised on youth-appealing television stations in Canada. While this study cannot assert that all this spending was used to target adolescents specifically, findings nevertheless suggest that Canadian youth are likely exposed to unhealthy food advertising across media channels.

PAB(T6)-311
A comprehensive review on the double burden of childhood malnutrition and micronutrient deficiencies in four Southeast Asian countries: prevalence, determinants, current gaps and potential solutions

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1. University of Leeds (UK)

Background and objectives: Several countries in Southeast Asia (SEA) face the rising challenge of the double burden of malnutrition (DBM) alongside micronutrient deficiencies (MND). This review examines the prevalence and determinants of DBM and MND, and identifies current gaps and potential strategies to address childhood DBM and MND in Indonesia, Malaysia, Thailand and Vietnam.

Methods: A comprehensive literature search was conducted in four databases to identify studies reporting the prevalence, determinants and approaches to tackling malnutrition and micronutrient deficiencies (iron, anaemia, vitamins A and D) in children under 19 years in the four SEA countries.

Results: 197 studies were identified. According to recent national surveys (2014-2020), prevalence of stunting in children under 5 (girls and boys) in Indonesia, Malaysia, Thailand, and Vietnam were 30.8% (29.7%, 31.7%), 21.8% (23.5, 20.2%), 13.4% (11.4%, 15.2%) and 19.6% (20.6%, 18.6%), respectively, especially higher in rural regions, 13.1-34.9% (*vs.* urban=12.4-27.3%). Overweight and obesity were more prevalent in older children (~5-19 years old) (Indonesia: 20.0%, Malaysia: 29.8%, Thailand: 12.4% and Vietnam: 19.0%), particularly higher in boys, 6.9-33.2% (*vs.* girls: 6.4-26.2%), and in urban regions, 15.5-33.7% (*vs.* rural: 11.2-26.9%). Low birth weight, low socio-economic status, low maternal height and education, suboptimal feeding practices and food insecurity were the factors commonly associated with undernutrition. Sedentary lifestyles, increased screen time and high-energy dense foods were associated with weight gain. Vitamin A deficiency (0.3-14.2%) was of less concern. Anaemia and iron deficiency varied from 4.0-55.6% and 5.2-44.9%, respectively, and were higher in girls and in rural regions, potentially caused by dietary practices, intestinal infection, thalassemia and hemoglobinopathies that merit further investigation. Vitamin D deficiency varied from 7-83%, and was higher in girls and in urban regions, possibly related to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

dietary practices (e.g., lower milk consumption), sun-avoidant lifestyles and religious practices. Intervention trials demonstrated the effectiveness of supplementation, fortification and obesity-related lifestyle programmes in improving child malnutrition, with limited data for nutrition-sensitive programmes to inform policy strategies.

Conclusion: DBM and MND remain significant public health concern in SEA, and the magnitude varied across the countries. More research is warranted to identify effective double-duty actions to end all forms of malnutrition.

Keyword: double burden of malnutrition, micronutrient deficiencies, children and adolescents, Southeast Asia, review

PAB(T6)-312
Unintended consequences of policy actions to reduce added sugar: The global rise of non-nutritive sweeteners

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Background and objectives: Humans have a biological preference for sweetness. Subsequently, the food industry has increasingly produced and promoted highly desirable and potentially addictive products sweetened with added sugars. Current added sugar intakes exceed recommendations, constituting a dietary risk for poor health. Policy actions to reduce consumption have been implemented internationally and may promote reformulation to reduce the added sugar content of packaged foods, often with the addition of non-nutritive sweeteners (NNS): non-caloric substances which impart sweetness. NNS health impacts and their effect on dietary patterns are contested. We aimed to assess whether there was an association between longitudinal trends in worldwide sales of added sugars and NNS and policy actions to reduce added sugar consumption.

Methods: We adopted a mixed methods approach, including a longitudinal trend-analysis of the apparent consumption of added sugars and NNS using per-capita market sales data from 2007-2019 from the Euromonitor Passport Database, and policy mapping of global policy actions to reduce added sugar consumption from The NOURISHING Database.

Results: NNS sales supplied by beverages increased globally (2g/capita, 36%). This was significantly ($p < 0.05$) correlated with the overall number of policy actions to reduce added sugar consumption and increased advertising regulations, food standards in public institutions and increased availability of healthy foods. Added sugar sales supplied by beverages, and the ratio of added sugar and NNS use, decreased in high-income countries (8kg/capita, 22%) but increased in upper- and lower-middle income countries (1kg/capita, 40% and 0.5kg/capita 13% respectively). Added sugar sales increased globally for packaged food (0.5kg/capita, 9%).

Conclusions: The use of NNS, and the sweetness of the packaged food supply, is increasing. These trends are associated with implemented policy actions to reduce added sugar consumption. Additionally, we suggest that NNS use is driven by industry responses to proposed policy; consumer demand for low energy/sugar products; favourable regulatory environments; and technological advances. Sweetener growth in middle-income countries is associated with an increased supply of ultra-processed foods associated with the 'nutrition transition'. The health and dietary impacts of our increasingly sweet food supply, and increased NNS intakes, will require ongoing monitoring to determine public health outcomes.

Keyword: Sugar, Non-Nutritive Sweeteners, Nutrition Policy, Food Policy

Conflict of Interest Disclosure: CR, PB, RL and CG have no conflicts of interest to declare. ML is a member of the FSANZ Board, the views expressed in this paper do not necessarily represent the views, decisions, or policies of FSANZ or the FSANZ Board

Further Collaborators: n/a

PAB(T6)-313
Reaching Zero-Dose Children: Delivering Vitamin A Supplementation (VAS) to Children 6-59 months in Hard-to-Reach Settings of Nigeria

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Background and Objective: Two-dose VAS coverage in Nigeria remains very low (41%). The inequity is more glaring in hard-to-reach settings (HTRS), worsened by the impact of COVID-19 pandemic. Nutrition International supported the government in Rivers, Cross Rivers and Sokoto states through its Covid-19 Emergency Response project to deliver two rounds of VAS in HTRS between September 2021 to June 2022. The objective is to reach eligible children in HTRS with VAS through extended outreach of the bi-annual maternal newborn and child health weeks (MNCHW).

Methods: Advocacy with state-level policy and decision makers was undertaken to increase commitment to extend VAS to the vulnerable children in HTRS. Mapping and categorization of hard-to-reach communities with security challenges, inaccessible/difficult road networks were conducted with the state MNCH teams using a participatory bottom-up micro-planning. The state consolidated micro plans were updated with this information ensuring HTRS were included and used to prioritize and deploy adequate human resources, commodities, data tracking tools and transport logistics to these areas. About 2,545 front-line health workers (FHW) and community resource persons drawn from the HTRS were trained and deployed to over 1,000 outreach sites across the three States. Town announcers and guides were mobilized to generate demand and facilitate

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DOI: 10.1159/000530786

safe entrance into these communities. 40 independent monitors were also trained and deployed to give real-time reports, including daily data reviews using WhatsApp platform.

Results: A total of 1,312,089 (90%) children 6-59 months received two -doses of VAS in HTRS across the three states. Of these, 787,769 children are additional due to the project.

Conclusion: This approach resulted in reaching children who are frequently missed with the MNCHWs in each of the states and in some cases had never been reached with VAS.

Keyword: Vitamin A Supplementation, Children 6-59 months, Hard-to reach, Nigeria

Further Collaborators: Mayowa Sotimehin, Association for Reproductive and Family Health, Nigeria

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PAB(T7)-1
Nutritional value and properties of plain bread made from powdered wood

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1. Koshien University (Japan)

Background and objectives: Dietary reference intake for Japanese (2020) indicates that the quantity of aim of the daily dietary fiber intake of Japanese people is more than 21 g for male from 18 years old to 49 years old. It indicates that the quantity of aim of the daily dietary fiber intake of Japanese people is more than 18 g for female from 18 years old to 49 years old. But the national health and nutrition survey Japan (2018) indicates that average of the daily dietary fiber intake of Japanese people is 14.4g. It indicates that average of the daily dietary fiber intake of Japanese people from 18 years old to 49 years old is 12.4g. Therefore, it should be recommended that we take dietary fiber positively. In addition, the most of thinning are discarded in the forest. We should consider that we use these resources effectively. We do not usually make it edible. But we suggest that we eat powdered wood in everyday life. We will do the suggestion of eating habits to take in dietary fiber positively.

Methods: Commercial edible powdered wood, strong flour, sugar, butter, powdered skim milk, salt, dry yeast were used for plain bread. We purchased powdered wood from Taruwakien (Shizuoka). Powdered wood of 0% or 3% or 5% or 10% of strong flour was included in plain bread. The bread was baked using a bake machine. Plain breads were cut the middle of the bread in a square. Using a rheometer, hardness of plain bread was measured. In addition, nutritive values were calculated.

Results: As ratios of powdered wood in plain bread increased, the hardness of plain bread increased. As ratios of powdered wood in plain bread increased, the quantity of dietary fiber in plain bread increased.

Conclusions: The plain bread containing the powdered wood is hard, but some people may enjoy a texture with the resistance to teeth of the bread. We will think that it is necessary to consider by sensory evaluation in future. It suggests that eating habits to take bread containing the powdered wood helps increase dietary fiber intake.

Keyword: powdered wood, plain bread, rheometer, dietary fiber

PAB(T7)-2
Maternal Perspectives on Probiotics and Probiotic Food Consumption of Children in Urban Communities in Laguna, Philippines

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Background and objectives: Probiotic consumption has been on the rise in the Philippine market. However, research has yet to be done on the level of knowledge and attitudes of mothers regarding these commercially-available probiotics. This study described the consumption of probiotics among children and its relationship with the maternal perspectives on probiotic food.

Method: This study is a cross-sectional, analytic study on 680 mothers and 680 children recruited in selected urban communities in Laguna, Philippines.

Results: Most mothers (92%, n=625) had highly positive attitude to probiotics. Composite scores were computed for questions on maternal attitude to probiotics, perceived behavioral control, and intention of giving probiotics to children. Path analysis was run to check for association and the resulting path showed significant association between attitude and intention, attitude and intake, behavioral control and intake, behavioral control and intention, and intention and intake of probiotic food. Female children (42.43%) have higher intake than males (30.61%). High intake was also noted among children of mothers with educational attainment of Vocational (45.45%) and College and higher (41.09%); among low- (38.92%) and middle-income families (44.06%). As for the frequency of consumption of probiotic food, 3 out of 10 of the respondents reported daily intake of at least one bottle of the probiotic foods enumerated.

Conclusion: Mother's attitude, perceived control and intention are positively associated with higher total intake among children. The intake of probiotics among children in the sample population was high. One out of three children consumed a probiotic drink daily.

Keyword: probiotic food among children, commercially-available probiotic foods, maternal perspectives on probiotics

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7)-3

Citrus tamurana Hort. Ex Tanaka (Hyuganatsu Orange) derived arabinogalactan suppresses bone turnover in postmenopausal women. A double blind, placebo-controlled study (DB-SAHBo Study)

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Background and objectives; We previously reported that water soluble substance of this orange suppresses osteoclast formation in ovariectomized rat and 3T3E1 cell. This substance was determined as arabinogalactan. We also showed that Hyuganatsu arabinogalactan stimulates fibroblast migration in vitro. From these basic findings, we then investigated a pilot clinical study to compare Hyuganatsu juice intake group and no treatment control group. Rates of changes between pre- and post-consumption were significantly increased in TRACP5b and P1NP concentration in the Hyuganatsu group. Therefore, in this study, we performed a double blind, randomized study on the effect of arabinogalactan rich Hyuganatsu juice on the bone metabolism.

Methods; 63 women were assigned to Hyuganatsu and placebo groups with stratification randomization. Hyuganatsu group took a paper pack containing 125ml of Hyuganatsu juice with arabinogalactan (31.3mg) every day for 90 days. Placebo group took a different juice in a same paper pack, which had similar flavor and color to Hyuganatsu juice and did not contain arabinogalactan.

Results; TRACP5b concentrations were not different between the 2 groups at the pre-intervention period, which were significantly different at 90-day treatment, and then became insignificant at 30-day recovery. Repeated measures linear mixed model analysis revealed a significant accumulation effect in TRACP5b. The temporal changes in P1NP were significantly different ($p<0.05$) and a significant accumulation effect was observed after 90-day treatment. There was no significant difference in other parameters.

Conclusions; Our results suggested that Hyuganatsu arabinogalactan serves as a useful functional food, which has some clinical efficacy for osteoporosis caused by ovarian hormone deficiency.

Keyword: Hyuganatsu orange, arabinogalactan, bone metabolism, double blind placebo control study

Conflict of Interest Disclosure: nothing

Further Collaborators: no

PAB(T7)-4

Comparison of the therapeutic potentials on functional properties of regulating lipid metabolism and intestinal/fecal lipid absorption between chitosan and chitosan oligosaccharide in high-fat diet-induced obese rats

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Background and Objectives: Chitosan and its derivative, chitosan oligosaccharide (CO), possess hypolipidemic and anti-obesity effects. A previous study found that the effects and mechanisms on improving lipid metabolism were different between 5% CO and 5% high-molecular-weight (MW) chitosan (HC)/5% low-MW chitosan (LC) in high-fat (HF) diet-fed rats for 8 weeks. However, it is still unclear if the mechanisms are different or similar between chitosan and CO. This study was designed to investigate and compare the effects of CO and HC on liver lipogenesis and lipid peroxidation, adipose lipolysis, and intestinal/fecal lipid absorption in HF diet-fed rats for 12 weeks.

Methods: Rats were randomly divided into four groups after a 1-week acclimation: normal control diet (chow diet) (NC), HF diet (chow diet+10% lard) (HF), HF diet+5% HC, HF diet+5% CO. The experiment period was 12 weeks.

Results: Both HC and CO supplementation could reduce liver lipid biosynthesis, but HC had a better effect than CO on improving liver lipid accumulation in HF group. Both HC and CO supplementation effectively reduced the increases in plasma and hepatic lipids, activated the AMPK activation, decreased the PPARγ protein expression, and decreased the lipogenesis-related enzyme (ACC, FAS, and HMGCR) activities in the livers. The increased triglyceride level and lipoprotein lipase activity and the decreased lipolysis rate in perirenal adipose tissues of HF group could be significantly reversed by both HC and CO supplementation. HC, but not CO, supplementation promoted liver antioxidant enzymes glutathione peroxidase and superoxide dismutase activities and reduced liver lipid peroxidation. HC supplementation significantly increased the fecal TC and TG levels, while CO supplementation slightly increased the fecal lipids levels. HC, but not CO, supplementation could significantly increase the amount of bile acid excretion into feces. HC mainly used its physical properties to increase lipid excretion and inhibit lipid absorption, while CO reduced lipid absorption by reducing the expression of *fabp2* and *fatp4* mRNA in the intestines.

Conclusions: These results suggest that HC and CO have different mechanisms for improving lipid metabolism in HF diet-fed rats. A long-term study may be needed to clarify the positive actions of CO in HF diet-induced obesity.

Keyword: Chitosan , Chitosan Oligosaccharide, Lipid Metabolism, High-Fat Diet-Induced Obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7)-5

Long-term supplementation with omega-3 fatty acids-enriched fish oil improves inflammation and protein synthesis/degradation signals and prevents skeletal muscle atrophy in an obese rat model

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Background and Objectives: Fish oil with an abundance of omega-3 fatty acids eicosapentaenoic acid and docosahexaenoic acid is a beneficial dietary supplement for improvement of metabolic disorders. Here, we investigated the beneficial effects and mechanisms of long-term supplementation with fish oil on obesity-related changes of muscle metabolism and muscle atrophy in rats.

Methods: High-fat (HF) diets were applied to induce obesity in male Sprague-Dawley rats with or without omega-3 fatty acids-enriched fish oil (FO; 5%) supplementation for 16 weeks. Control mice were fed with normal diet.

Results: Diets supplemented 5% FO showed a significant decrease in the final body weight and body weight gain compared to HF diet-fed rats (n=8, $p<0.05$). Diet supplementation of FO decreased blood total cholesterol and triglyceride and tumor necrosis factor-α levels in HF diet-fed rats (n=8, $p<0.05$). The muscle fiber atrophy (decreased cross-sectional area) of gastrocnemius, soleus, tibialis anterior, and extensor digitorum longus muscles in HF diet-fed rats could be improved by FO supplementation (n=8, $p<0.05$). FO supplementation increased phosphorylated FOXO3A and decreased Atrogen-1 and MuRF1 (muscle atrophy-related proteins) protein expression in soleus muscles of HF diet-fed rats (n=4-6, $p<0.05$). The activation of adenosine monophosphate (AMP)-activated protein kinase (AMPK) in muscle is known to enhance glucose uptake, fatty acid oxidation, and mitochondrial biogenesis. The peroxisome-proliferator-activated receptor-γ coactivator 1α (PGC-1α) is a downstream signaling of AMPK. FO supplementation could significantly activate AMPK phosphorylation and PGC-1α protein expression in soleus muscles of HF diet-fed rats (n=4, $p<0.05$). FO supplementation could also increase the phosphorylation of Akt/mTOR/p70s6k (protein synthesis pathway) in soleus muscles of HF diet-fed rats (n=4-6, $p<0.05$).

Conclusion: These results suggest that diet supplementation of FO exerts a beneficial improvement in imbalance of muscle metabolism in obesity. The increases in signaling pathways of AMPK/PGC-1α and Akt/mTOR/p70s6k and the decrease in signaling pathway of FOXO3/muscle atrophy-related proteins are involved in the FO-prevented obesity-induced muscle atrophy.

Keyword: Fish Oil, Skeletal Muscle, Obesity, Muscle Atrophy-Related Proteins

PAB(T7)-6

Bioavailability of prenylated isoflavones, glyceollins, in Sprague-Dawley rats

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Background and objectives: It has been evidenced that prenylation of isoflavones displayed apparent physiological effects rather than their mother isoflavones (*e.g.* daidzein and genistein), while their bioavailability remains unclear. This study, thus, aims to obtain insight on the bioavailability of prenylated isoflavones, glyceollins, in Sprague-Dawley (SD) rats, in terms of intestinal absorption and subsequent tissue distribution.

Methods: Glyceollins (glyceollin I and III) obtained from germinating soybeans and daidzein (as control) were orally administered to the rats (1.0 mg/kg) and blood samples from tail veins collected at 0.5, 1, 4, and 8 h were subjected to an LC-TOF/MS analysis. Deconjugation treatments with β-glucuronidase Type B-I and sulfatase Type H-I were performed to evaluate the amounts of conjugates. Ex vivo transport experiments using rat jejunum membrane were also performed to examine pharmacokinetics of glyceollins. Furthermore, accumulation of absorbed glyceollins in organs was assayed using organs (the liver, kidneys, heart, lung, soleus muscle, and abdominal aorta) taken at 0.5, 1, 3, 6, and 24 h after a single administration.

Results: LC-MS analysis revealed that glyceollins I and III, as well as daidzein, were absorbed in conjugated forms, but not intact forms into rat circulating bloodstream. Absorption of conjugated forms of glyceollin I was > 8-times higher than that of daidzein ($AUC_{0-8\ h}$: glyceollin I, 8.5 ± 0.7 nmol·h/mL-plasm; glyceollin III, 1.0 ± 0.2 nmol·h/mL-plasma; daidzein, 0.6 ± 0.1 nmol·h/mL-plasma), depending on their hydrophobicity or log *P*. MS analyses of blood sample also demonstrated that conjugated forms of glyceollins were sulfated, glucuronidated, and methylated ones. After intestinal absorption, glyceollins were found to be distributed into the circulatory organs rapidly (T_{max} of 0.5 h), in the order of the liver > kidney > heart > lung > soleus muscle and abdominal aorta. In contrast, daidzein and hydroxy equol were accumulated only in the liver and kidneys at lower concentrations (1/100-times), compared to glyceollins.

Conclusions: This study demonstrates that prenylation of isoflavones caused high bioavailability into blood and organs rather than their mother isoflavones in their conjugated forms.

Keyword: glyceollins, isoflavone, prenylation, bioavailability

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7)-7

Neutraceutical and medicinal insights on the antidiabetic and anti-pancreatic cancer activity of *Morus rubra* Linn: disruption of crosstalk between G protein-coupled receptor and insulin receptor signaling systems

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Background and objectives: Pancreatic cancer cells exhibit crosstalk between G-protein coupled receptor (GPCR) and insulin receptor (IR) signaling pathways. Disruption of the crosstalk by metformin was previously elucidated with anti-diabetic activity and AMP kinase (AMPK) activation leading to mTOR antagonism. This study probed whether a semi-purified ethyl acetate fraction of *Morus rubra* (red mulberry) bark (M1) can also impede the signaling crosstalk in pancreatic cancer cells.

Methods: The cytotoxic activity of M1 in BxPC-3 cultured with insulin (10 ng/mL) and GPCR agonist angiotensin II (Ang II) (5 nmol/L) was assessed via PrestoBlue® assay. Half maximal inhibitory concentration (IC_{50}) after 72 hours was extrapolated using GraphPad Prism. BxPC-3 was challenged with M1 IC_{50} to quantify intracellular Ca^{2+} induction ($[Ca^{2+}i]$) and AMPK phosphorylation fluorescence by Ang II followed by DNA synthesis activity via absolute telomere length (aTL) through qPCR. M1 phytochemical constituents were profiled by GC-MS and the identified compounds were subjected to molecular docking with AMPK via AutoDock Vina.

Results: Viability assessment of BxPC-3 afforded an IC_{50} of 5.503 µg/mL after M1 treatment suggesting high antiproliferative activity. Subsequently, treatment of BxPC-3 with insulin and Ang II for 5 minutes displayed significant increase in $[Ca^{2+}i]$. However, pretreatment with M1 IC_{50} completely abrogated insulin-induced $[Ca^{2+}i]$ potentiation which was not observed with the effect of Ang II alone. M1 also negated DNA synthesis revealed by significant decrease in aTL. Additionally, anchorage-dependent growth induced by insulin and Ang II were also inhibited after 24-hour incubation. M1 promoted sustained increase in AMPK phosphorylation but addition of dosomorphin (5 µmol/L), a selective AMPK inhibitor, reversed the effects of M1 on $[Ca^{2+}i]$ and aTL inferring that AMPK activation is the underlying M1-driven mechanism. GC-MS analysis afforded lupeol and γ-sitosterol as main potential bioactive compounds inferred from molecular docking to the three AMPK binding sites (BS). Lupeol showed high affinity to BS1 (-9.5 kcal/mol) while γ-sitosterol exhibited -8.6 and -7.9 kcal/mol to BS2 and BS3, respectively, demonstrating higher affinities than metformin (-4.7 kcal/mol).

Conclusions: These results raise the prospect that *Morus rubra* could be a source of novel phytochemical leads for the treatment of diabetes and human pancreatic cancer.

Keyword: Morus rubra, anti-diabetes, anticancer, phytochemicals, in silico

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T7)-8

Action mechanism of low molecular weight peptides, Trp-Val (WV) and Ala-Trp (AW) by oral glucose tolerance test animals

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Objective: We found dipeptidylpeptidase (DPP) IV activity inhibition in protease-enzymatic decomposition products of bonito stock lees [Methods and Results] A 10 % ethanol-eluting fraction (N5-2 fraction) (IC_{50}=73.71 µg/ml) was obtained from N5 using a Sep-Pak C18 column. Trp-Val (0.14%; Trp-Val content 15.24 mg/100 g N5-2 fractions, DPP IV inhibition IC 50 values; 11.21 µ g/ml) was identified The addition of 400 mg/ml of the N5-2 fraction to Caco-2 cell membranes significantly ($p<0.05$) inhibited DPP IV activity, suggesting that the N5-2 fraction inhibits DPP IV activity on cell membranes in human small intestinal epithelial cells. N5-2 fractionwas administered before glucose administration (100 mg/kg) , followed by 1 g/kg BW glucose, and the blood glucose level was measured in the blood collected from the tail vein . The increase in blood glucose level was significantly ($p<0.05$) suppressed at 30 min compared with the control group mice. It was identified using UPLC and LC-MS. For Trp-Val (WV) and Ala-Trp (AW), 100 mg concentrations were used in the oral OGTT test and were significantly (5%) inhibited by placebo and at each time [Conclusion] Trp-Val (WV) and Ala-Trp (AW) are suggested to be the major dipeptides in the protease enzymatic degradation products of dried bonito lees.

Keyword: peptide, DPPIV, WV, AW

Conflict of Interest Disclosure Conflict of Interest Disclosure (if any)

PAB(T7)-9

Development of skin permeable L-theanine gel for premenstrual syndrome

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Background and objectives: Premenstrual syndrome (PMS) with anxiety and tension of the breast is developed about 80 percent of women in Japan. L-theanine is specific amino acid in green tea and it has especially affected relaxation in PMS. However, the efficacy of L-theanine is not defined well because its blood half-life is short. Thus, we think that the gelation of L-theanine would improve skin permeability and have a long half-life in blood. In this study, we examined preparation method, characterization, and skin permeability of the L-theanine contained gel.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: L-theanine gels were prepared by different combination ratios of stearic acid, stearyl alcohol, and propylene glycol, and some preparation methods. Permeability of L-theanine in gel formulation was evaluated using franzcell with Strat-M membrane. Spreadability of these gels were evaluated by spread meter. *In vivo* experiment, mice were applied the L-theanine gel on their back for 7 days, and the L-theanine level in the blood were determined.

Results: L-theanine in solution did not permeate the Strat-M membrane at all. In contrast, L-theanine in the gel was permeated time dependently. When L-theanine content in gel formulation was changed from 5 to 40%, the permeable amount of L-theanine was increased at 20%. The L-theanine gel was prepared by heating and melting the mixture at 83℃ of stearic acid, stearyl alcohol, and propylene glycol in the ratio of 1:2.4:18(w/w) and 20% L-theanine had the best permeability and spreadability. *In vivo* experiment, serum level of L-theanine in gel treated group was higher than that of solution group.

Conclusion: The L-theanine gel, which was consisted of stearic acid, stearyl alcohol, and propylene glycol in the ratio of 1:2.4:18(w/w) and 20% L-theanine, had the best permeability, spreadability and L-theanine level in mice serum. These results suggested that L-theanine gel is useful for symptom relaxation of the PMS.

Keyword: Premenstrual syndrome, L-theanine, Gel, Skin permeability, Female disease

PAB(T7)-10
Development of green tea with reduced caffeine and its properties

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Background and objectives: Green tea (*Camellia sinensis*) is a traditional beverage that provides physiological health benefits; however, caffeine is one of the main components of green tea and has side effects such as sleeplessness. Senior citizens, children, and pregnant women should avoid tea despite its known beneficial effects. In this study, we developed green tea with reduced caffeine content (low-caffeine tea) as a palatable tea that can be offered to everyone. Further, the physiological function of the tea was assessed.

Methods: Fresh tea leaves (Camellia sinensis) were plucked and automatically sprayed with hot water (95°C, 180 seconds) to reduce the caffeine content of tea leaves. After centrifugal dehydration at 3000 rpm for 1 min, the green tea was prepared through a standard manufacturing process. The tea leaf infusions were applied to a reversed-phase high-performance liquid chromatography to determine the caffeine, catechin, and theanine contents. In addition, the anti-oxidative activity was investigated using a stable free radical and the anti-lipase activity using an artificial substrate to assess the physiological function of the tea.

Results: We successfully produced a low-caffeine tea infusion with 30% caffeine content. In the low caffeine tea infusion, the concentrations of other main components, such as catechins and theanine, did not differ from green tea as a control. In addition, there were no significant differences between the infusions of low caffeine tea and green tea in anti-oxidative and anti-lipase activities.

Conclusions: The results showed that our developed low caffeine tea could be an attractive, high-quality tea with health benefits for everyone.

Keyword: Green tea, Caffeine, Antioxidant, Functional food

PAB(T7)-11
Anti-inflammatory mechanism of EGCG by suppressing expression of Elf-1

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Background and objectives: Toll-like-receptor 4 (TLR4) is an important membrane protein for innate immunity and induces the secretion of inflammatory cytokines by recognizing Lipopolysaccharide (LPS) which are constituents of the outer membrane of gram-negative bacteria. Abnormal inflammation through TLR4 signaling leads to the induction of sepsis and insulin resistance. In previous reports, we revealed that green tea catechin (−)-epigallocatechin-3-O-gallate (EGCG) increased the expression of Toll-interacting protein (Tollip), one of the negative regulators for TLR4 signaling pathway, and suppressed the expression of inflammatory cytokines in macrophages. In this study, we examined the molecular mechanism of EGCG induced Tollip expression in macrophages.

Methods: The macrophage cell line RAW264.7 cells were treated with EGCG. The nuclear expression of E74-Like Factor 1 (Elf-1), which is a transcriptional repressor of Tollip, Protein phosphatase 2A (PP2A) activity, and phosphorylation level of endothelial nitric oxide synthase (eNOS) were measured. Female C57BL6J mice were treated with LPS (0.05 mg/kg i.t.) and administrated with EGCG (15mg/kg p.o.).

Results: EGCG reduced Elf1 expression level in nuclei. Activity of PP2A and phosphorylation levels of eNOS were upregulated by EGCG. Also, PP2A inhibitor suppressed EGCG-elicited Tollip expression. Akt inhibitor and NOS inhibitor treatment suppressed the increase of Tollip expression by EGCG. In addition, the cGMP synthase inhibitor also inhibited the increasing the expression of Tollip by EGCG. The cGMP synthase activator induced activation of PP2A, decreased expression of Elf-1 in the nucleus, and increased expression of Tollip. EGCG suppressed lung inflammation status in acute lung injury model.

Conclusions: We found that EGCG increases Tollip expression by reducing Elf-1 nuclear expression through the Akt / eNOS / sGC / cGMP/ PP2A pathway.

Keyword: EGCG, Tollip, inflammation, Elf-1, cGMP

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7)-12

Polyunsaturated fatty acids-rich dietary lipid prevents high fat diet-induced obesity in mice

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Background and objectives: Diet is the most important factor affecting host nutrition and metabolism; however, excess food intake, especially high-calorie diets, such as high-fat and high-sugar diets, has led to an increased risk of obesity. And, obesity results in changes in the composition of gut microbiota, as well as reductions in microbial diversity, and changes in specific bacterial taxa. Although dietary lipids can alter the composition of gut microbiota in obese mice, it is unclear how the compositions of polyunsaturated fatty acid in dietary lipids regulate the gut microbiota and affect the host energy homeostasis. Here, we demonstrated that the difference of polyunsaturated fatty acids composing dietary lipid improves metabolic conditions in high fat diet-induced obesity.

Methods: C57BL/6J male mice were fed normal chow (NC), high-fat diet (soybean oil), or modified high fat diet (linseed oil, fish oil, or olive oil) for 8 weeks. After feeding, body weight changes, tissue weights, biochemical analysis, glucose tolerance test, and gut microbiota were analyzed.

Results: The intake of the different polyunsaturated fatty acids-rich dietary lipid improved metabolic conditions in high fat diet-induced obesity by regulating glucose tolerance and insulin resistance. Gut microbial compositions were different among high-fat diet and each modified high fat diet fed mice.

Conclusions: In conclusion, these results suggested that a new mechanism underlying the function of the difference of polyunsaturated fatty acids composing dietary lipid in assistant regulating host energy homeostasis in obesity.

Keyword: dietary lipids, polyunsaturated fatty acids, obesity, gut microbiota

PAB(T7)-13

Zeolite improves high-fat diet-induced hyperglycemia, hyperlipidemia and obesity in mice

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Background and objectives: Zeolite, an abundant mineral in the Earth's crust, is utilized in a wide range of fields because of its well-known adsorption properties. Its application as a functional food ingredient resembling dietary fiber is expected, but it has not yet been investigated in the context of prevention of lifestyle-related diseases. The present study was designed to evaluate the availability and safety of a natural zeolite preparation for this purpose.

Methods and Results: Acute oral toxicity testing showed that the lowest lethal dose (LDLo) of zeolite was more than 2,000 mg/kg body weight for both male and female mice. In a prolonged feeding test for 18 weeks using model mice with high-fat-induced obesity and type 2 diabetes mellitus, intake of a 10% zeolite-containing diet suppressed body weight gain, as well as liver and visceral fat weights, without any changes in food and energy intake. Moreover, plasma lipid (triacylglycerol, total cholesterol and high-density-lipoprotein cholesterol) levels and fasting blood glucose levels decreased in parallel with zeolite intake. No changes in the glycated hemoglobin level were found. However, in an oral glucose tolerance test at week 12, increased postprandial blood glucose levels were suppressed in accordance with zeolite intake, and then insulin secretion was also decreased. On the other hand, a decrease of plasma amylase activity and increases in total bilirubin and urea nitrogen suggested the need for further investigation of safety.

Conclusions: The present study has determined the LDLo of this new natural zeolite preparation and shown that when taken as a dietary component it is able to improve hyperglycemia, insulin sensitivity and chronic lipid metabolism disorders in model mice with high-fat diet-induced obesity and type 2 diabetes mellitus.

Keyword: zeolite, lowest lethal dose, hyperlipidemia, type 2 diabetes mellitus, obesity

Conflict of Interest Disclosure: KK has no competing financial or non-financial interests, has not received any consulting fees/honoraria, has no leadership/advisory role in the company, and receives no patent royalties/licensing fees or other benefits (e.g., gifts).

Further Collaborators: Because YK is an employee of Bikensangyo Co., Ltd., he has a financial competing interest, a non-financial competing interest, has received a salary, and has a leadership/advisory role in the company.

PAB(T7)-14

Similar distribution of eicosapentaenoic acid and mesenchymal stem cells in the abdominal aortic aneurysm wall

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Background and objectives: Abdominal aortic aneurysm (AAA) is a vascular disease with progressive dilatation of the abdominal aorta, eventually resulting in rupture. At this time, no preventive methods for AAA have been established. It is reported that AAA development is closely associated with aortic inflammation. Previous studies suggested that eicosapentaenoic acid (EPA) has suppressive effect on AAA development via anti-

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

inflammatory activities in various animal AAA model. However, relationships between anti-inflammatory activities of EPA and cells in AAA wall are poorly understood. To investigate the cells in AAA wall which can be associated with anti-inflammatory effects of EPA, we visualized the distribution of EPA-containing phosphatidylcholine (EPA-PC) in animal AAA wall by matrix-assisted laser desorption ionization-mass spectrometry imaging (MALDI-MSI), which can visualize the distribution of molecules of interest in tissue sections.

Methods: The animal experiments were approved by the Institutional Animal Care and Use Committee and conducted according to the Kindai University Animal Experimentation Regulations (approval number KAAG-31-006). In this study, 6-week-old male SD rats were used to induce AAA by abdominal aortic ligation procedure after 1 week of preliminary rearing. MALDI-MSI revealed characteristic distribution of EPA-PC in animal AAA wall, suggesting the existence of cells which preferentially incorporate EPA into their cell membranes. To identify the cells, the regions in the AAA wall were divided into two groups: EPA-PC-low and EPA-PC-high. Immunohistochemical analysis was performed to screen cells of which distribution are similar to EPA-PC.

Results: As the result, we found the distribution of CD44, a mesenchymal stem cells (MSCs) marker, was similar to the distribution of EPA-PC. Previous studies have reported that MSCs are associated with aortic inflammation and abnormal adipogenesis in aortic wall, which result in AAA development or rupture.

Conclusions: These data suggest EPA can be preferentially incorporated into MSCs and attenuate the dysfunction of MSCs in AAA wall.

Keyword: AAA, EPA, MSCs, MALDI-MSI

PAB(T7)-15
Effects of *Undaria pinnatifida* (wakame) on postprandial glycemia: in vitro and in vivo studies

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Background and objectives: Brown seaweeds like *Undaria pinnatifida* (wakame) contain sodium alginate which could affect postprandial blood glucose levels. We previously reported the effects of wakame on postprandial glycemia in humans; however, the underlying mechanism is unclear. The purpose of this study was to investigate the mechanism of ingested wakame's influence on postprandial blood glucose levels.

Methods: We conducted in vitro studies to determine the inhibitory activity of wakame on glucose release rate and α-glucosidase activity and in vivo studies to determine the acute effects of wakame on postprandial blood glucose levels in young Japanese women. The in vitro study assessed wakame powder, fat-free wakame powder, soluble and insoluble fractions obtained from dried wakame, and commercially available sodium alginate. Glucose release rate was measured using the in vitro digestion model, and α-glucosidase activity was measured using the maltase reaction. The in vivo study was conducted using a crossover method where healthy young adult participants were given 150 g of rice with or without wakame soup (2 g dried wakame) or wakame salad (4 g dried wakame). Blood glucose levels were measured at 0, 15, 30, 45, 60, 90, and 120 min after meal consumption.

Results: The glucose release rates of all wakame products and sodium alginate were significantly lower than those of control. The soluble fraction significantly inhibited glucose release. No significant difference was found in α-glucosidase activity. In the in vivo study, blood glucose levels 15 min after ingestion were significantly lower after consuming rice with wakame soup than when consuming rice alone. Moreover, ingestion of wakame salad also resulted in significantly lower blood glucose levels at 15, 30, and 45 min after meal consumption.

Conclusions: These results suggest that the highly viscous soluble fraction of wakame, which contains sodium alginate, increases the viscosity of gastrointestinal contents and delays glucose absorption.

Keyword: Undaria pinnatifida, wakame, glucose releasing rate, postprandial blood glucose

PAB(T7)-16
Effect of maternal quercetin intake during lactation on renal inflammation in high fructose-fed female rat offspring exposed to maternal undernutrition

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Background and objectives: Maternal undernutrition during pregnancy and lactation is known to induce renal disease in later life. High fructose intake causes metabolic syndrome, which results in an increased risk of chronic kidney disease development. Quercetin is one of the flavonoids and possesses various physiological functions. For instance, it has been reported to attenuate high-fructose-feeding-induced atherosclerosis by suppressing inflammation. Moreover, quercetin is involved in the activation of autophagy. We investigated the effects of quercetin intake during lactation on inflammation in the kidneys of high fructose-diet-fed adult female offspring exposed to maternal normal-protein or low-protein diets.

Methods: Pregnant Wistar rats received diets containing 20% (NP) or 8% (LP) casein, and 0 or 0.2% quercetin containing NP diets (NP/NP or NP/NPQ) in experiment (Expt.) 1 and 0 or 0.2% quercetin containing LP diets (LP/LP or LP/LPQ) in Expt. 2 during lactation. At weaning (week 3), pups that received a diet

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DOI: 10.1159/000530786

of distilled water (Wa) or 10% fructose solution (Fr) were divided into six groups: NP/NP/Wa, NP/NP/Fr, and NP/NPQ/Fr in Expt. 1, and LP/LP/Wa, LP/LP/Fr, and LP/ LPQ/Fr in Expt. 2. At week 12 after treatments, macrophage infiltration, mRNA levels of TNF-α and IL-6, and markers of autophagy flux in the kidneys of female offspring were examined.

Results: The number of macrophages in the tubulointerstitium of the kidneys of the NP/NPQ/Fr group was significantly lower than that in the NP/NP/Fr group. In the LP/LPQ/Fr group, the macrophage number was significantly lower, compared with the LP/LP/Fr group. The TNF-α and IL-6 mRNA levels increased in the kidneys of the NP/NP/Fr or LP/LP/Fr, respectively. Conversely, the IL-6 mRNA levels in the NP/NPQ/Fr or LP/LPQ/Fr decreased. LC3B-II levels were downregulated in the NP/NP/Fr or LP/LP/Fr. In contrast, LC3B-II levels were upregulated, while p62 protein levels were downregulated in the NP/NPQ/Fr and LP/LPQ/Fr.

Conclusions: Our results suggested that quercetin intake during lactation may cause long-term alterations in inflammation and autophagy flux in the kidneys of high fructose-diet-fed adult female offspring.

Keyword: quercetin, maternal undernutrition, inflammation, fructose, rat

PAB(T7)-18
The promotion of Japan's system of Foods with Function Claims and development of "balanced and healthy meals" to improve dietary habits

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Background and objectives: In Japan, there is a system of Foods with Function Claims (FFC) that contributes to health based on scientific evidence. The FFC exist in the form of processed and fresh foods as well as pills. Foods included in the system of FFC has been enforced to help people choose the right foods for maintaining and improving their health. The dietary recommendations are based on the premise a diet of well-balanced meals should be supplemented staple foods, main dishes, and side dishes. Therefore, we developed a nutritionally balanced menu using foods in the system of FFC, with "balanced and healthy meals." We aim to make this system more accessible to the public and motivate individuals to improve their dietary habits.

Methods: A menu was prepared by setting the nutritional value of each food in the system of FFC based on its expectation to improve blood pressure, blood glucose, blood lipids, etc., while considering the recommended daily intake amount and referring to national standards. And we disseminated it.

Results: We developed about 80 "balanced and healthy meals" and disseminated them to the public through conference presentations, newspaper articles, and lectures. The responses of the participants after the lectures on FFC use, including "balanced and healthy meals," revealed that more than 90% of the participants achieved an increased health and dietary habit awareness, to varying degrees.

Conclusions: Our results suggest that the dissemination of FFC from Japan's unique system of FFC by registered dietitians as "balanced and healthy meals" for the maintenance and promotion of public health could, under correct use, provide a useful health education method to improve health and dietary habits.

Keyword: Foods with Function Claims (FFC), balanced and healthy meals, registered dietitians

PAB(T7)-19
Effect of Sea Buckthorn Berry Extract on Allergy and Inflammation

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Background and Objectives: While the immune system is an important biological defense mechanism against the infection of pathogens, an excessive immunological response can cause physiological injuries. In type-I allergy, the specific binding of antigens to immunoglobulin E antibodies on the membrane of mast cells and basophils induces the cell stimulation, causing various symptoms by releasing chemical mediators such as histamine and leukotrienes (LTs). In inflammation, viral or bacterial infections and the allergic reaction stimulate macrophages, which release nitric oxide (NO) and the cytokines involved in inflammatory signs. Sea buckthorn (*Hippophae rhamnoides* L.) is a deciduous shrub belonging to the family Elaeagnaceae. Sea buckthorn berries are used for many healthy foods, although the physiological functions are not clear. In this study, the anti-allergic and anti-inflammatory effects of sea buckthorn berry extracts were investigated *in vitro*.

Methods: Freezed sea buckthorn berries were homogenized with methanol, and the supernatant after the centrifugation was evaporated. The extract was subjected to reversed-phase column chromatography and fractionated by the gradient elution with 0-100% methanol. After the evaporation, the total polyphenol content of each fraction was determined. The rat basophilic leukemia cell line (RBL-2H3) was stimulated by antigen-antibody reaction, and the released histamine and intracellular signal transduction were analyzed. The mouse bone marrow-derived mast cell line (PB-3c) was stimulated with calcium ionophore, and the generated LTB4 was measured. The mouse macrophage-like cell line (RAW 264.7) was stimulated with lipopolysaccharide and the released nitric oxide (NO) was quantified, and the inflammatory cytokines were measured.

Results: Total polyphenol content was highest in the 80% methanol-eluted fraction. This fraction significantly suppressed histamine release and LTB4 production from the cells, as well as

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DOI: 10.1159/000530786

tyrosine phosphorylation. The 80% methanol-eluted fraction significantly inhibited NO release from the cells, as well as the release of IL-1β, IL-6, and TNF-α, which are associated with the initial inflammatory response.

Conclusions: The results suggest that sea buckthorn berries may alleviate type-I allergy by inhibiting the release of chemical mediators and inflammation by inhibiting the release of NO and cytokines from macrophage, in which the polyphenols in the fraction may contribute to the inhibitory activities.

Keyword: Sea buckthorn, Allergy, Inflammation, Polyphenols

PAB(T7)-20
Contents and functions of catechins and free amino acids in microorganism-fermented teas

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Background and objectives: Microorganism-fermented tea is a rare type of tea that is fermented by microorganisms, such as lactic acid bacteria. We have previously shown that Sichuan dark tea, a microorganism-fermented tea, had a suppressive effect on lipid metabolism and the development of atherosclerosis in a rat model of diet-induced atherosclerosis, compared with green tea. The purpose of the present study was to determine the biochemical properties of Japanese and Chinese microorganism-fermented teas *in vitro*.

Methods: Six types of microorganism-fermented tea were investigated, and green tea was used as a control. The antioxidant capacity (The 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity), enzyme inhibitory activity (against a-glucosidase, lipase, and hyaluronidase), and anti-allergic activity of the teas were evaluated in *in vitro* tests. The anti-allergic activity was assessed via degranulation inhibition tests conducted using the rat basophil-like cell line RBL-2H3 as an indicator of b-hexosaminidase release activity. The catechin and free amino acid contents were determined by HPLC.

Results: The antioxidant activity was more than 50% at 1 mg/mL in Awa-bancha, green tea, Go-ishi tea, and Ishizuchi dark tea. a-Glucosidase inhibitory activity was generally low, but Awa-bancha, Goishi tea, and green tea showed 30%–40% activity. In lipase inhibitory activity, all the microorganism-fermented teas, except Bataba tea, showed more than 50% activity at 1 mg/mL, and green tea and Awa-bancha showed more than 90% activity, followed by Sichuan dark tea and Goishi tea. The hyaluronidase inhibitory activity was different from the results for the other enzyme inhibitory activities, with Bataba tea and green tea showing more than 50% activity at 1 mg/mL, followed by Puer tea. b-Hexosaminidase release activity showed a decrease in the order green tea, Sichuan dark tea, Awa-bancha, and Ishizuchi dark tea at 100 μg/mL.

Conclusions: We determined the functionality of six types of Japanese and Chinesemicroorganism-fermented teas *in vitro*. In the future, we plan to investigate the relationship between the functional properties and the catechin and free amino acid content of the teas.

Keyword: microorganism-fermented tea , food functionality, catechins, free amino acid, in vitro tests

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PAB(T7)-21
Effect of *Nigella sativa* L. on degranulation in mast cells and immunoglobulin production in mouse spleen lymphocytes

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Background and objectives: *Nigella sativa* L. (black cumin) has been reported to contain active ingredients, including thymoquinone, which has anti-inflammatory properties, but the anti-allergic effects of *Nigella sativa* L. have not been fully elucidated. In this study, we investigated the anti-allergic effect of black cumin seeds and the inhibitory mechanism.

Methods: Black cumin seeds (BCS) were crushed and sequentially extracted using *n*-hexane, ethyl acetate, 100% methanol, 50% methanol, and water, and then dissolved in DMSO. The evaluation of degranulation inhibition was performed using the rat basophilic leukemia cell line RBL-2H3 as an indicator of β-hexosaminidase, and the intracellular Ca^{2+} concentration was measured for evaluation of the degranulation inhibition mechanism. For the evaluation of antibody production capacity, the spleens of type I allergy model mice were collected and lymphocytes were isolated. Lymphocytes were cultured for 72 h under co-stimulation with egg white albumin (OVA) alone or samples to measure OVA-specific IgE, IgG1, and IgG2a.

Results: The recovery rates for the extracts were 21.9% with *n*-hexane, 2.4% with ethyl acetate, 3.8% with 100% methanol, 8.7% with 50% methanol, and 1.9% with water. In the degranulation inhibition test, a decrease in β-hexosaminidase-releasing activity was observed for all extracts, except the hexane extract at a concentration of 100 µg/mL. In particular, a strong decrease was observed for the 100% methanol, 50% methanol, and water extracts, with IC_{50} values of 1.2, 0.8, and 2.5 µg/mL, respectively. In addition, significant inhibition of the increase in intracellular Ca^{2+} levels was observed for the 100 % and 50 % methanol, water extracts.

Conclusions: An anti-allergic effect of BCS was observed, suggesting that there are active components in the 100% methanol, 50% methanol, and water extracts that inhibit degranulation, and the inhibitory mechanism appeared to be related to inhibition of the increase in intracellular Ca^{2+} concentration. The antibody production capacity will be evaluated and the results will be reported in this presentation.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Nigella sativa L., RBL-2H3, spleen lymphocytes, degranulation, immunoglobulin production

PAB(T7)-22
Cholesterol-lowering pentapeptide IIAEK (lactostatin) specifically interacts with intestinal alkaline phosphatase to improve cholesterol metabolism

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Background and objectives: IIAEK (Ile-Ile-Ala-Glu-Lys, lactostatin) is a novel cholesterol-lowering pentapeptide derived from bovine milk β-lactoglobulin. However, the molecular mechanism underlying the IIAEK-induced intestinal cholesterol absorption remains unclear. In this study, we identified the target protein interacting with IIAEK and evaluated whether IIAEK specifically interacted with the target protein to improve cholesterol metabolism.

Methods: We tested the effect of IIAEK on intestinal cholesterol metabolism using Caco-2 cells as a human intestinal model (1). We chemically synthesized a novel molecular probe, IIXEK, which can visualize a complex of target proteins interacting with photoaffinity-labeled IIAEK by fluorescent substances for photoaffinity labeling (1). We used photoaffinity labeling and nano LC-MS/MS analyses using IIXEK to capture and identify the target protein that interacted with IIAEK (1). We evaluated the direct interaction between IIAEK and the target protein using surface plasmon resonance (SPR). We studied whether IIAEK targets IAP to improve cholesterol metabolism using the introduction of IAP siRNA into Caco-2 cells.

Results: We found that IIAEK significantly reduced the expression of intestinal cholesterol metabolism-associated genes, particularly that of the ATP-binding cassette transporter A1 (ABCA1). Through photoaffinity labeling and MS analysis with IIXEK for intestinal lipid raft fractions of Caco-2 cells and rat intestinal mucosal proteins, we identified intestinal alkaline phosphatase (IAP) as a specific molecule interacting with IIAEK and discovered the common IIAEK-binding amino acid sequence, GFYLFVEGGR (1). Surprisingly, studies using SPR showed the specific interaction of IIAEK with human IAP was 2.63 times stronger than that of *in vivo* substrate of IAP (vitamin B_6). Also, the alanine scanning of IIAEK (e.g. IAAEK) disappeared the IIAEK-IAP interaction. Interestingly, the introduction of IAP siRNA counteracted the IIAEK-induced decrease in ABCA1 mRNA levels in Caco-2 cells.

Conclusions: We found that IIAEK specifically interacted with intestinal alkaline phosphatase (IAP) in the amino acid sequence-dependent manner to improve cholesterol metabolism with specific activation of IAP and downregulation of ABCA1 (1).

(1) Takeuchi, A. *et al. Nutrients* 12, 2859 (2020).

Keyword: IIAEK, alkaline phosphatase, Caco-2 cell, surface plasmon resonance, cholesterol

PAB(T7)-23
Novel antidepressant-like peptide in collagen hydrolysate

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Background and objectives: Our previous results demonstrated that food-derived peptides exhibited antidepressant-like activity by oral administration. Collagen is the most abundant protein in vertebrates. In this study, we tested whether collagen hydrolysate or its constituting peptides show antidepressant-like activity by oral administration. Then, we investigated the hippocampal mechanism underlying the antidepressant-like effects of collagen peptides.

Methods: We tested depression-like behavior by forced swim test in normal mice and in corticosterone-administered mice. This test was carried out for 6 min and the immobility time was measured. Collagen hydrolysate or its constituting peptides, which was dissolved in saline was administered orally 3 hours before the test. Antagonists of neurotransmitters associated with depression-like behavior were administered intraperitoneally 30 min before the ingestion of collagen hydrolysate, peptides, or amino acids. The amount of neurotransmitter in hippocampus were measured by HPLC-ECD system. The number of hippocampal neural progenitor cells was measured *in vivo* and *in vitro* by counting specific marker-positive cells. Also, we measured expression of hippocampal growth and neurotrophic factors by real time RT-PCR.

Results: Collagen hydrolysate exhibited antidepressant-like activity after oral administration in normal and corticosterone-administered mice. The antidepressant-like activity of collagen hydrolysate was inhibited by SCH23390, an antagonist of dopamine D_1 receptors. Amount of dopamine in hippocampus was significantly increased after oral administration of collagen hydrolysate. Prolyl hydroxyproline (Pro-Hyp), which was circulated stably after digestion and absorption of collagen hydrolysate, also exhibited antidepressant-like activity. The constituent amino acids had no effect on depression-like behavior. Pro-Hyp increased several gene expressions of growth and neurotrophic factors in hippocampus and promoted proliferation of hippocampal neural progenitor cells *in vivo* and *in vitro*. Together, these results suggest that collagen hydrolysate exhibits antidepressant-like activity and promotes proliferation of hippocampal progenitor cells via dopamine pathway. Also, Pro-Hyp was found as an active peptide of antidepressant-like activity.

Conclusions: We found that Pro-Hyp exhibits antidepressant-like activity after oral administration, probably

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

through activation of dopamine pathway, neurotrophic factor, and neurogenesis in mice.

Keyword: Emotional behavior, Depression, Peptide, Collagen

PAB(T7)-24
Combination effects of quercetin and various prebiotics on the flavonoid metabolism and intestinal flora in rats.

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Background and objectives: Quercetin is known to exhibit various physiological actions including antioxidantion. Quercetin has a low absorption rate. We previously showed that most of ingested quercetin flows into the large intestine are decomposed by the intestinal flora. The flavonoid metabolites produced by intestinal microbes also exert physiological effects. The purpose of this study is to investigate changes in the intestinal flora when quercetin and three types of nondigestible oligosaccharides [fructooligosaccharides (FOS), lactosucrose and raffinose] are ingested by rats for two weeks, and to investigate the amount of residual quercetin aglycon in the large intestine as part of quercetin metabolism.

Methods: Male Sprague-Dawley rats were given AIN-93G based test diets containing 1% quercetin with or without 3% FOS, lactosucrose, or raffinose for 2 weeks. On the last day, the cecum with their contents were collected after killing under an anesthesia. Quercetin derivatives in samples were measured by LC/MS analyses. Microbiome profiles in the cecum contents were examined by 16SrRNA sequencing.

Results: The amount of remaining quercetin aglycone in the cecum were much higher in the three prebiotic groups, especially in raffinose group, which agrees with our previous results and indicates the oligosaccharides suppress quercetin decomposition by intestinal flora. Microbiome analyses in the cecal contents showed changes in the populations of Firmicutes, Verrucomicrobia, and Actinobacteria phylum in the all oligosaccharide groups. The Firmicutes phylum was increased in the FOS and lactosucrose group compared to the control and raffinose groups, whereas the Verrucomicrobia was decreased in the FOS and lactosucrose group compared to the control group. Actinobacteria phylum increased most in the raffinose group, followed by in the FOS group, but not in the lactosucrose group. These changes in intestinal flora may affect decomposition of quercetin aglycone.

Conclusion: Combination intakes of oligosaccharides and quercetin are expected to alter the microbiome profiles and beneficial effects of quercetin with changes in its metabolism, and the effects may depend on type of prebiotics.

Keyword: Quercetin, Nondigestible oligosaccharides, Intestinal flora

Conflict of Interest Disclosure: This work was supported by JSPS KAKENHI Grant Number JP17K12908.

PAB(T7)-25
Potential skin protective effects against photoaging of sea cucumber derived indigestible peptide

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Background and objectives: Sea cucumber (*Stichopus japonicus*) (SC) has been used as food ingredient and folk medicine for centuries in Asian countries. In the present study, we examined the potential effects of SC and its enzymatic hydrolysate (SCH) on photoaging *in vivo*. Photoaging is characterized by skin dysfunctions and wrinkle formation primarily caused by chronic exposure to ultraviolet (UV) irradiation. Moreover, *in vitro* studies were conducted to explore the potential photoprotective activity of a peptide remained after *in vitro* digestion of SCH to understand potential mechanisms.

Methods: Hairless Hos:HR-1 mice in experimental groups were exposed to UVA at a dose of 20 J/cm^2 five times weekly for 10 weeks, fed with a diet of AIN-93G containing 5% sea cucumber powder or its hydrolysate. Every four weeks, the transepidermal water loss (TEWL) was measured and dorsal skin was replicated using silicone for analysis of wrinkle formation. After 10 weeks, the mice were sacrificed, and dorsal skin specimens were collected for morphological analysis as well as mRNA expression analysis. Furthermore, *in vitro* protease digestion using endo- and exo-proteases was conducted to SC and SCH, followed by evaluating the anti-photoaging capacity of the indigestible peptide using normal human dermal fibroblast (NHDF).

Results: UVA significantly induced transepidermal water loss and wrinkle formation in hairless mice, which were significantly mitigated upon oral administration of SC and SCH. Additionally, SC and SCH mitigated the UVA-induced downregulation of epidermal natural moisturizing factors. Through *in vitro* digestion, Gly-Pro was found to be a main peptide in the endo- and exo-proteases digest of SCH. Further study showed that Gly-Pro inhibited the UVA-driven generation of reactive oxygen species (ROS) in NHDF in a culture system, and attenuated UVA-induced changes in mRNA expression and the activation of proteins in MAPK-NF-κB signaling pathway.

Conclusions: Dietary SC and SCH exert anti-photoaging effects *in vivo*, probably by modulating filaggrin synthesis and desquamation in the epidermis. Moreover, Gly-Pro found in the protease digest of SCH has potential applications as an anti-photoaging reagent.

Keyword: sea cucumber, anti-photoaging, collagen hydrolysate, bioactive peptide, NF-κB

Conflict of Interest Disclosure: Sunsho Pharmaceutical Corporation funded this study and provided support for the author Tatsuya Sugawara. The other authors state no conflict of interest.

PAB(T7)-26
Effects of synbiotics on muscle protein metabolism in chronic alcohol-fed rats

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Background: Chronic alcohol consumption might lead to intestinal microbiota dysbiosis and endotoxemia. Endotoxemia could cause the increase of muscle loss including autophagy through gut-muscle axis. The purpose of this study is to investigate whether synbiotics supplementation can ameliorate the muscle loss by improving intestinal health in rats with chronic alcohol feeding.

Materials and methods: Thirty 8 weeks old male Wistar rats were divided into control group (n=12) and synbiotics group (n=18), which were given 2 weeks of control liquid diet and provided with distilled water (control group) or synbiotics solution (synbiotics group, 1.5g/kg BW/day). At the 3rd week of the experiment, control group was divided into 2 groups, one was given control liquid diet (C group) and the other one was given ethanol liquid diet (E group). The synbiotics group was divided into 3 groups such as control diet with synbiotics solution (SC group), ethanol liquid diet with synbiotics solution (ASE group), and ethanol liquid diet with distilled water (PSE group). During the experimental period, all groups were isoenergetic pair-feeding based on E group and sacrificed at the 8th week.

Results: E group showed liver damage including higher AST and ALT activities, hepatic fatty changes, inflammation and higher CYP2E1 protein expression. Intestinal occludin and claudin-1 mRNA expressions were significantly decreased and the plasma endotoxin level was significantly higher in E group. In muscles, E group had a significantly higher beclin-1 protein expression and a trend of higher TLR-4 protein expression. Compared to E group, PSE and ASE groups had lower plasma ALT activities, hepatic fatty changes, CYP2E1 protein expressions. PSE and ASE groups had significantly higher occludin and claudin-1 mRNA expression and lower muscle beclin-1 and TLR-4 protein expression when compared to E group.

Conclusion: In conclusion, synbiotics supplementation might inhibit muscle protein degradation by lowering muscle beclin-1 expression which might be linked to the improvement of intestinal health in chronic alcohol fed rats.

Keyword: Alcoholic liver disease, Synbiotics, Gut-muscle axis, Liver-muscle axis

PAB(T7)-27
Hesperidin promotes NO production and Mas receptor expression in human umbilical vein endothelial cells by binding to a transient receptor vanilloid 1

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Background and objectives: In the previous study, we revealed that hesperidin exerted an anti-hypertensive effect via upregulation of aortic MasR expression in spontaneously hypertensive rats[1]. The aim of this study was to clarify the underlying mechanisms of hesperidin-stimulated aortic MasR expression in human umbilical vein endothelial cells (HUVECs).

Methods: HUVECs were cultured with hesperidin (1 µM, 2 h) in the presence or absence of vasomotor-related signal inhibitors, following the measurement of nitric oxide (NO) production in cell culture medium and vasomotor-related protein expression in cells.

Results and Discussion: Hesperidin (1 µM, 2 h) exhibited a significant NO promotion ($p < 0.01$). Among the receptors relating to NO production (AT_1R, AT_2R and MasR), only MasR expression was significantly increased ($p < 0.01$), whereas a MasR antagonist had no effect on the level of the hesperidin-induced NO production. In contrast, a transient receptor potential vanilloid 1 (TRPV1) antagonist significantly abolished the hesperidin-induced NO production ($p < 0.01$). By knockdown of TRPV1 or inhibition of Ca^{2+}/calmodulin-dependent kinase II (CaMKII) and p38 mitogen-activated protein kinase (p38 MAPK), the increased MasR expression was disappeared. Inhibitions of CaMKII and eNOS also caused the abolishment of hesperidin-induced NO production. These results indicated that hesperidin binding to TRPV1 may activate two axes: TRPV1/CaMKII/p38 MAPK/MasR axis and TRPV1/CaMKII/eNOS/NO axis.

Conclusion: This study provides the first finding that hesperidin preferably binds to TRPV1 in HUVECs, leading to the activation of two signaling axes of CaMKII/p38 MAPK/MasR and CaMKII/eNOS/NO.

[1] G. Gao *et al*. *Food Sci. Technol. Res.* **2020**, *26*, 779–787.

Keyword: hesperidin, Mas receptor, TRPV1, NO, anti-hypertensive effect

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7)-28
The influence of dietary composition on anti-obesity effects of D-allulose in rats

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Background and Purpose: D-allulose (D-psicose) is a rare sugar with zero calories and 70% sweetness compared to sucrose. Recently, many studies have shown the anti-obesity effect of D-allulose by suppressing lipogenesis and increasing energy expenditure. However, these studies have been conducted under low-fat (high-carbohydrate) dietary conditions because D-allulose primarily affects carbohydrate metabolism. Conversely, under extremely low-carb conditions, D-allulose may not exert its anti-obesity effect, and there may be specific thresholds for dietary nutrient composition for D-allulose to function. .. In this study, rats were fed a diet supplemented with 5% D-allulose under conditions of gradually varying proportions of dietary fat (10% to 20% (Experiment 1), 25% to 35% (Experiment 2)). Gave to The effect of dietary nutrient composition on the anti-obesity effect of D-allulose was investigated.

Methods: 84 male Wistar rats (3 weeks old) were randomized into 12 groups of 7 rats. The respective groups were the 10F, 15F, and 20F groups fed a diet containing 10%, 15%, and 20% fat, and 10FP, 15FP, and 10FP fed a diet containing 5% D-allulose. It was a 20FP group (Experiment 1). Similarly, the 25F, 30F, 35F, 25FP, 30FP, and 35FP groups were classified (Experiment 2). In each experiment, rats were given a free experimental diet for 8 weeks and then sacrificed.

Results: Two experiments confirmed the significant effect of D-allulose on reducing body fat accumulation. Conversely, the effect of dietary fat percentage on body fat accumulation was confirmed only in Experiment 2, which is a high-fat diet condition. In Experiment 1, it was found that the total fat mass was significantly lower in the 15FP group than in the 15F group. On the other hand, in Experiment 2, it was found that the 25FP and 30FP groups had significantly less total fat mass than the 25F and 30F groups, but no significant difference was observed between the other F-FP groups. ..

Conclusion: These results suggest that the anti-obesity effect of D-allulose is exerted even under high-fat diet conditions, but the exact threshold cannot be determined.

Keyword: D-Allulose, Rare sugar, Anti-obesity effect

PAB(T7)-29
Effect of ketone bodies on lipid metabolism: focusing on skeletal muscle

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Background and objectives: Ketogenic diet, consisting of high-fat and low-carbohydrate diet promotes ketone body production. Ketone bodies are made from free fatty acids in the liver when carbohydrates cannot be used as energy source, and are released into the blood to be used by the brain and skeletal muscles. Generally, concentration of ketone bodies in the blood is 0.2 mM, which increases to 1.0 mM after prolonged exercise or 24 h of fasting, and can be as high as 20 mM under diabetic ketoacidosis. Recently, beta-hydroxybutyrate (βHB) has been reported to act not only as energy source but also as signaling molecule. However, the function of βHB in skeletal muscle has not yet been completely explained. In this study, we investigated the effects of βHB on skeletal muscle, focusing on lipid metabolism.

Methods: Gene expression analysis of βHB treated C2C12 myotubes was performed using qRT-PCR. The GAL4 reporter assay was used to evaluate the transcriptional activity of PGC1 and FOXO. In addition, the effects of FOXO1 overexpression on the lipoprotein lipase (LPL) promoter activities were examined by transfection of HEK293T cells with reporter plasmids. Mitochondrial activity was also evaluated using MitoTracker.

Results: Gene expression of LPL, which is important for lipid metabolism, increased in a βHB concentration-dependent manner. Also, the expression of genes known to increase LPL expression was increased (FOXO, PGC1, PPAR). Interestingly, the expression of LPL, which is increased by 24 h fasting (fasting-induced increased FOXO expression), was suppressed in skeletal muscle-specific FOXO-deficient mice. The transcriptional activity of FOXO1 and FOXO3a increased in a βHB concentration-dependent manner. Furthermore, FOXO1 expression increased LPL promoter activity, but the effect of βHB addition could not be observed. Mitochondrial activity was not affected by βHB.

Conclusions: In this study, we observed that LPL expression and transcriptional activity of FOXO was increased by βHB. Furthermore, gene expression of LPL was increased by fasting but decreased by FOXO-deficient mice. These results suggest that FOXO is involved in the increase of LPL expression by βHB.

Keyword: ketone bodies, lipid metabolism, LPL, FOXO, skeletal muscle

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7)-30

Delphinidin suppresses disuse muscle atrophy and upregulates microRNA-23a-3p expression in extracellular vesicles derived from intestinal cells

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Background and objectives: Delphinidin, a major anthocyanidin, exhibits beneficial properties including anti-oxidative, anti-cancer and anti-inflammatory effects. In addition, delphinidin prevents disuse muscle atrophy[1]. MicroRNA (miRNA) is one class of small noncoding RNAs that regulates target gene expression. We revealed that delphinidin increased miR-23a-3p[1] that suppresses muscle atrophy[2]. However, the mechanism has been poorly understood. This study aimed to elucidate the mechanism of miR-23a-3p expression induced by delphinidin in skeletal muscle.

Methods: 20 mg/kg body weight delphinidin was orally administered to C57BL/6J mice for 7 days and measured the miR-23a-3p expression in small intestine, skeletal muscle and plasma by qRT-PCR. Differentiated human intestinal epithelial-like Caco-2 cells were incubated with delphinidin, and miR-23a-3p level was evaluated by qRT-PCR. C2C12 myotubes with or without dexamethasone, an inducer of muscle atrophy, were treated with extracellular vesicles (EVs) derived from Caco-2 cells incubated with delphinidin. The expressions of miR-23a-3p and MuRF1, one of the muscle atrophy-related genes, were measured by qRT-PCR.

Results: Delphinidin intake increased miR-23a-3p expression in plasma and quadriceps. Delphinidin upregulated miR-23a-3p expression level in basolateral EVs secreted from Caco-2 cells. Additionally, the basolateral EVs derived from delphinidin-treated Caco-2 cells upregulated miR-23a-3p expression and downregulated MuRF1 expression in C2C12 cells.

Conclusions: Delphinidin upregulated miR-23a-3p expression in basolateral EVs from intestinal cells. The uptake of its EVs into skeletal muscle cells increased miR-23a-3p level and decreased MuRF1 expression in skeletal muscle, indicating that it may prevent muscle atrophy.

Keyword: Delphinidin, MicroRNA, Extracellular vesicles, Muscle atrophy

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PAB(T7)-31

A study on the association between anti-obesity effects of lactoferrin and genetic variations

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Background and objectives: For advancements in functional food science, clarification of the relationship between the health effects of food intake and genetic variations is a critical issue, but it has barely been addressed. Therefore, a genome-wide association study (GWAS) was carried out to investigate an association between the anti-obesity effects of lactoferrin (LF), a milk-derived protein, and genetic variations.

Methods: A 12-week, placebo-controlled, randomized, double-blind, parallel-group comparative study was conducted in healthy Japanese men and women. The subjects were administered enteric-coated LF or placebo tablets. Before and after the administration of tablets, obesity-related parameters, such as visceral fat area and body mass index (BMI), were evaluated. The data were obtained from approximately 700,000 single nucleotide polymorphisms (SNPs) and a lifestyle questionnaire, such as daily food intake and exercise. The association between the rate of change in the parameters and the SNPs was analyzed using linear regression analysis adjusted by subject attributes, such as age and sex.

Results: The GWAS analysis revealed that several SNPs were potentially associated with the anti-obesity effects of LF, such as visceral fat area and BMI reduction. These SNPs were selected based on the p-value of the association in the LF group and the interaction between the LF and the placebo group. Furthermore, the annotation data showed that missense mutations are contained in these SNPs. Additionally, prediction models of the anti-obesity effects of LF were created using subject attributes, SNPs, and lifestyle data using a step-wise regression method. The coefficients of determination of all the prediction models on the effects of LF, such as visceral fat area and BMI reduction, were >0.8.

Conclusions: The GWAS indicated that genetic variants could be involved in the anti-obesity effects of LF. This observation could help utilize functional foods based on an individual's constitution and lifestyle.

Keyword: lactoferrin, genetic variations, GWAS, functional food, obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-32)
Effect of black tea residue on glucose and lipid metabolism in mice

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Background and objectives: Many people are suffering from food shortages. On the other hand, a lot of foods are wasted every day. Food loss and food waste also includes waste during the food manufacturing process. The purpose of this study is to find out the effectiveness of black tea residue generated in the process of manufacturing black tea beverages. In this study, we investigated the effect of black tea fiber intake on glucose and lipid metabolism in mice.

Methods: Black tea residues were provided by the beverage factory and were freeze-dried and powdered for use. 5-week-old male ICR mice were preliminarily reared for 2 weeks and divided into two groups. The control group fed a standard diet (AIN-93M), and the experimental group fed identical diet supplemented with 3% black tea residue for 6 weeks. During the feeding period, body weight was measured once a week. The HbA1c level was measured on the last week of the feeding period. On the last day of the feeding period, blood was collected and measured for blood glucose, triglyceride, and total cholesterol. In addition, the weight of three adipose tissues (perirenal, epididymal and mesenteric) were measured.

Results: From fourth week of feeding period, the body weight of the black tea residue group tended to be lower than the control group. The weight of perirenal, epididymal and mesenteric adipose tissues of black tea residue group tended to be lower than the control group. The HbA1c ($p < 0.05$), blood triglyceride ($p < 0.01$), and total cholesterol ($p < 0.05$) value were significantly lower in the black tea residue group than in the control group.

Conclusions: These results suggest that long-term intake of black tea residue may suppress body fat accumulation. In addition, long-term intake of black tea residue showed an effect of suppressing the HbA1c, blood triglyceride, and total cholesterol elevation. Hence, this study suggests that black tea residue is useful for controlling glucose metabolism and lipid metabolism.

Keyword: Black tea, glucose metabolism, lipid metabolism, metabolic syndrome, food residue

Further Collaborators: Black tea residue was provided by Kirin Beverage Company, Limited

PAB(T7-33)
Epidermal hydrating and anti-melanogenic effects of rice-derived glucosylceramides and elasticamide on cell basis evaluation

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Background and objectives: Skin ceramides (Cer) are lipids mainly existing in stratum corneum and play pivotal rolls on epidermal hydrating and barrier function. In terms of plant-derived major Cer, glucosylceramides (GlcCer) dominantly exist in wide variety of botanical resources. Among them, GlcCer are well studied about clinical effects on skin barrier function. As other biological effects of GlcCer on skin, maize cerebroside mixture has been reported to suppress melanogenesis in B16 melanoma cells. Beside GlcCer fraction, there are free Cer as minor constituents including elasticamide (ceramide[AP]). However, no study results have been reported regarding epidermal hydrating and anti-melanogenic effects of these single molecules of GlcCer and elasticamide. In this study we have evaluated epidermal moisturizing activity and anti-melanogenic effects of rice GlcCer and elasticamide.

Methods: Epidermal hydrating effects on the reconstructed human epidermal keratinization (RHEK) model were evaluated by measuring transepidermal water loss (TEWL) chronologically after adding samples (10 μM) to the membrane side of RHEK. For evaluation of elasticamide in RHEK, we determined Cer contents by TLC and measured mRNA and protein expressions of Cer synthesizing enzymes. On the other hand, anti-melanogenic effect in B16 melanoma cells was performed inducing melanogenesis by theophylline. For elasticamide and GlcCer[d18:2 (4*E*, 8*Z*)/20:0], we also evaluated anti-melanogenic effects in a human 3D cultured epidermal melanocytes and mRNA expressions of melanin synthesizing enzymes and ATP concentration in normal melanocytes.

Results: As a result of evaluation of TEWL, 10 μM of 4*E* ,8*Z* type GlcCer including GlcCer[d18:2(4*E*, 8*Z*)/18:0], GlcCer[d18:2(4*E* /8*Z*)/20:0], GlcCer[d18:2(4*E*/8*Z*)/22:0], GlcCer[d18:2(4*E* /8*Z*)/24:0], GlcCer[d18:2(4*E* /8*Z*)/26:0] and elasticamide decreased TEWL. Among GlcCer, TEWL was improved depending on the length of fatty acids and GlcCer[d18:2(4*E*/8*Z*)/26:0] exhibited most potent hydrating effect. The hydrating effect of elasticamide was stronger than GlcCer[d18:2(4*E*/8*Z*)/26:0]. Moreover, elasticamide (14.3 μM) significantly increased total Cer and Cer[NS/NDS] with enhancing expression of GlcCer synthase. On melanogenesis in B16 melanoma cells, GlcCer[d18:2(4E, 8Z)/18:0], GlcCer[d18:2(4*E*, 8*Z*)/20:0], and elasticamide suppressed melanin production with IC50 values: 6.6, 5.2, and 3.9 μM. Elasticamide but not GlcCer[d18:2 (4*E*, 8*Z*)/20:0] suppressed melanogenesis in a human 3D cultured epidermal melanocytes and tyrosinase related protein-1 (TYRP-1) expression in melanocytes.

Conclusions: Rice-derived GlcCer were found to exhibit fatty acid length-dependent epidermal hydrating effects. Elasticamide showed strongest hydrating effect with enriching Cer[NS/NDS] by enhancing GlcCer synthase expression. On the other hand,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

GlcCer [d18:2(4*E*, 8*Z*)/18:0] and GlcCer [d18:2(4*E*, 8*Z*)/20:0] suppressed melanogenesis in B16 melanoma cells. However, the structure-activity relationship of GlcCer was not clarified except the fact that longer fatty acid length potentiated cytotoxicity. Elasticamide suppressed melanogenesis without cytotoxicity in both melanoma cells and normal melanocytes. Suppression of TYRP-1 was involved in the suppressive mechanism of elasticamide. Our result showed that elasticamide is one of the promising skin whitening compound in rice Cer with strong barrier function.

Keyword: Glucosylceramide, elasticamide, trans epidermal water loss, melanin, rice

PAB(T7-34)
Roasted chicken breast extracts interfere with muscle protein synthesis

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Background and objectives: Prevention of muscle atrophy is essential to support healthy aging. It is well known that adequate protein intake is necessary to prevent muscle atrophy. Still, there are few research reports on what meats are suitable for the prevention of muscle atrophy. We compared the effect of beef, pork, or chicken breast feeding on immobilization-induced muscle atrophy.

Methods: Experimental diets based on AIN-93M were prepared by replacing casein with meat flake of roast duck, roast chicken breast, roast pork fillet, or roast beef thigh. The protein, lipid, and carbohydrate contents in diets were adjusted to be identical. Male mice (9 wk old, C57BL) were fed one of the experimental diets. The ankle of the right limb was immobilized using a cast tube at 10–12 wk old, after which the cast was removed and sacrificed at 13.5 wk old. The tibialis muscle was collected at 12 and 13.5 wk. Muscle atrogin-1 mRNA and S6K protein levels were evaluated. Hydrophobic and hydrophilic extracts were prepared from the roasted chicken breast using liquid-liquid extraction method. C2C12 cells were cultured in the chicken extract-added medium. Cell proliferation rate and protein synthesis capacity were measured.

Results: Immobilization decreased the tibialis muscle weight by 21%. Meat type did not have a significant effect on muscle loss. Following release from the cast tube, muscle weight increased by 12% in the control food group but was not increased in the chicken breast food group and duck meat food group. Atrogin-1 mRNA expression was not significantly different among the groups. Phospho-S6K in the chicken breast food group was significantly lower than in the control group. In vitro study, C2C12 cell proliferation was suppressed in the medium added 10 mg/mL hydrophobic extracts from the chicken breast but not hydrophilic extracts. The protein synthesis level of C2C12 cells was attenuated when cells were cultured in 10 mg/mL hydrophobic extracts for 24 hours.

Conclusion: Consumption of large amounts of the roasted chicken breast may inhibit recovery from muscle atrophy. We found that this inhibitory effect may involve hydrophobic molecules with antiproliferative and protein synthesis properties in roasted chicken breast.

Keyword: Sarcopenia, frailty, SUnSET assay

PAB(T7-35)
Nutrient profiling of different land races of Bamboo rice (*Bambusa arundinacea* Willd) collected from the southern Western Ghats of India

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Background and objective: Bamboo rice refers to seeds of edible wild bamboo grass (*Bambusa arundinacea* Willd). It forms a major part of diet of the tribal people of Western Ghats of South India. They are highly dependent on bamboo rice during its flowering season and generally use it as a rice substitute. The study was intended to address the lacunae in available literature on bamboo rice. The objectives of the study were to determine the proximate composition, vitamins, minerals including trace elements, fatty acid composition, individual and total polyphenolic content and the antioxidant activity exhibited by different land races of bamboo rice.

Methods: Bamboo rice samples were collected from six different regions of the Southern Western Ghats of India for analysis and compared with commonly consumed rice varieties. The proximate composition was analysed using AOAC procedures. The vitamins and individual polyphenols were analysed using the HPLC techniques. Macro minerals were analysed using AAS and the trace elements were quantified using ICP-MS. The fatty acid composition was estimated using GC-FID. The total polyphenolic content was determined using the Folin Ciocalteu method. Antioxidant activity was evaluated on the basis of scavenging capacity of 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals, 2,2′-azino-di-[3-ethylbenzthiazoline sulphonate] (ABTS) radical cations and by ferric reducing antioxidant power.

Results: Bamboo rice had a higher content of the proximate components protein and total dietary fiber and had a lesser fat content when compared to the commonly consumed rice varieties. They were significantly rich in the minerals zinc, iron, copper and calcium and had a higher content of polyphenols namely gallic acid, protocatechuic acid, protocatechuic acid, sinapic acid, 4-coumaric acid and luteolin 7-O-glucoside. Bamboo rice exhibited a higher antioxidant activity against ABTS radical cations. The total polyunsaturated fatty acid content was higher in Bamboo rice.

Conclusions: Bamboo rice was found to have a good nutrient profile when compared to few commonly consumed rice varieties in India. Owing to its significant contribution to the

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

environment, extensive research needs to be carried out to reduce the long vegetative growth phase of bamboo and hence improve its cultivation and thereby increase the availability of bamboo rice.

Keyword: Bamboo rice, Nutrient composition, Bambusa arundinacea

PAB(T7-36)
The volatile compounds and aroma profile of various rice bran after solid-state fermentation

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Background and objectives: Rice bran is one of the by-products produced from the rice milling process with beneficial nutrients and bioactive compounds. Solid-state fermentation (SSF) is well known to improve the bioactivity and aroma profile of rice bran. These studies were undertaken to analyze volatile compounds and aroma profiles of various varieties of rice bran without (non-fermented rice bran, NFRB) and after SSF with *Rhizopus oligosporus* (fermented rice bran, FRB).

Methods: Four varieties of rice (Ciherang, Inpari30, IR64, and Inpari42) bran were used in these studies. The volatile compounds were analyzed by headspace-solid phase microextraction coupled with GC/MS and the aroma profile was characterized by qualitative descriptive analysis (QDA).

Results: There were seventy-two and sixty-eight compounds identified in FRB and NFRB, respectively. They are aldehydes, ketones, alcohols, acids, esters, fatty acids, phenol, benzenes, furan, thiazole, pyrazines, pyridine, lactones, terpenes, and hydrocarbons. The QDA with ten trained panelists described nine aromas such as rancid, smoky, musty, grassy, green, earthy, cereal, and sweet in FRB and NFRB. The SSF enhances fermented aroma in FRB. Furthermore, there was a relationship between volatile compounds and aroma descriptions of various rice bran varieties.

Conclusion: These studies proved that fermentation can increase the variety of volatile compounds as well as improve the sensory profile of rice bran.

Keyword: Aroma profile, rice bran, solid-state fermentation, volatile compounds

PAB(T7-37)
Preventive Role of Gnetin C against Nonalcoholic Fatty Liver Disease (NAFLD) in Mice Model

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Background and objectives: Non-alcoholic fatty liver disease (NAFLD) is the most common form of chronic liver disease, the global prevalence of which is approximately 25%. NAFLD can progress to hepatic steatosis, liver inflammation, and advancing fibrosis with an increased risk of cirrhosis. Resveratrol, a natural polyphenol, having anti-cancer, antioxidant, and anti-inflammatory properties, is found to be beneficial for prevention and cure of multiple metabolic diseases. Gnetin C which is a resveratrol derivative and is thought to have similar health promoting properties. Our current research intended to investigate the role of these food ingredients as a preventive measure for NAFLD in mice model as well as comparison between the protective effects of gnetin C and resveratrol.

Methods: NAFLD model mice were established by feeding C57BL/6J male mice with choline and methionine deficient high fat diet (HFD). The experiment was continued for 12 weeks with four groups- control (Research diet Inc. A06071314M), NAFLD (HFD; Research diet Inc. A06071318M), gnetin C (HFD + gnetin C) and resveratrol (HFD + resveratrol).

Results: Diet supplementation with gnetin C could successfully reduce the body weight gain, liver weight and improved blood glucose level as well as insulin sensitivity. Hepatic steatosis was found to be reduced by both gnetin C and resveratrol supplemented diet indicated by decreased fat droplets in H & E-stained liver sections, which was also confirmed by the liver lipid content. Hepatic fibrosis induced by high fat diet was successfully ameliorated by gnetin C and resveratrol supplementation. Results from mRNA expressions and western blot analyses showed that gnetin C and to some extent resveratrol downregulated fibrosis markers and improved anti-fibrotic genes in the TGF-β signaling pathway indicating possible safeguarding mechanism of both polyphenols against NAFLD.

Conclusion: The results suggest that dietary supplementation with gnetin C may have protective effects against fat deposition as well as hepatic fibrosis.

Keyword: NAFLD, resveratrol, gnetin C, hepatic fibrosis, hepatic steatosis

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-38)
Examination of methods for inhibition of rat small intestinal disaccharidase activity by resistant maltodextrin

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Background and objectives: Resistant maltodextrin (RMD) is a water-soluble dietary fiber made from starch and is widely used as an ingredient in functional foods. The mechanism by which RMD inhibits postprandial blood glucose elevation is generally thought to be due to inhibition of absorption of monosaccharides generated by hydrolysis of sugars, rather than inhibition of digestion. However, the inhibitory effects of RMD on intestinal maltase and sucrase activities also have been reported. In this study, we compared the inhibitory effects of RMD by measuring the amount of glucose (Glu-method) and fructose (Fru-method) released by rat intestinal sucrase and isomaltase. We also evaluated the inhibitory effects of RMD using *p* nitrophenyl-α-glucopyranoside *p* NPG).

Methods: Rat small intestinal disaccharidases were prepared by Kessler's method[1]). Sucrase and isomaltase activities were determined by Dahlqvist's assay with a slight modification[2]).

Results: Inhibition of RMD on sucrase activity was dose-dependent by the Glu-method while the Fru-method showed lower and no dose-dependent inhibition. As for inhibition on isomaltase activity, the Fru-method also showed a lower inhibition rate than the Glu-method. The reason for the different inhibition rates obtained by the Glu- and Fru- methods may be attributed to the blank sample which includes glucose released from RMD by digestion. In the Glu-method, the inhibition rate is calculated by subtracting the release of glucose from RMD. The blank sample reaction, in which RMD and the digestive enzyme react with each other under the condition that the substrate is not included, may result in greater hydrolysis of RMD than under the condition that the substrate is included. Therefore, we considered that glucose amount from the blank sample was overestimated in the Glu method, and as a result, the inhibition rate was apparently increased. Another evaluation of the inhibition of RMD on α-glucosidase activity using *p* NPG showed a similar inhibition rate to the Fru-method, which supports the fact that the inhibition rate obtained by Glu-method is overestimated.

Conclusions: We confirmed that RMD had certain inhibitory effects on rat intestinal sucrase, isomaltase, and α-glucosidase activities.

Keyword: Resistant maltodextrin, Disaccharidase, α-Glucosidase, Inhibitory effects

Biochem. Biophys. *Acta*, 506, 136-154 (1978)
Anal. Biochem, 7, 18-25 (1964)

Conflict of Interest Disclosure: This work was partly supported by the funding from Matsutani Chemical Industry Co., Ltd.

PAB(T7-39)
Identification of G protein-coupled receptors GPR55 and GPR97 as molecular targets of curcumin and involvement of GPR55 in the antidiabetic function of curcumin

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Background and objectives: The identification of molecular targets of bioactive food components is important to understand the mechanistic aspect of their physiological functions. Curcumin is the predominant bioactive curcuminoid in turmeric (*Curcuma longa*), which is widely used as a spice for preparing curry. Activities of curcumin, such as anti-diabetic properties, have been widely investigated. However, the molecular mechanisms by which curcumin exerts its biological effects have not yet been fully elucidated. Recently, G protein-coupled receptors have been identified as molecular targets of food factors.

Methods: We have developed an expression screening system using a luciferase reporter assay that enables to determine the activation of G protein-coupled receptors (GPCRs) by food components. HEK293FT cells were transfected with GPCR expression vectors and a p4xCRE-3xSRE-TATALuc2P reporter vector followed by stimulation with curcumin. Using a number of natural and synthetic curcumin analogs we examined the structure-activity relationship between curcumin and the identified receptors. The regulation of glucagon-like peptide-1 (GLP-1) secretion by curcumin via one of the identified receptors was investigated using GLUTag enteroendocrine L-cells.

Results: After screening 258 human GPCRs, we identified GPR55 and GPR97 as targets of curcumin. Structure-activity relationship analysis shows that both the methoxy group and the heptadienone moiety of curcumin were required for activation of both GPR55 and GPR97. Docking simulation and luciferase reporter analysis using GPR55 mutants showed that the F190 residue of GPR55 was important for the interaction with curcumin. The curcumin-induced secretion of glucagon-like peptide-1, an incretin hormone that promotes insulin secretion, and intracellular calcium levels in GLUTag cells were inhibited by a GPR55 antagonist.

Conclusions: Expression screening was a useful system to identify GPCRs as targets of food components. We have identified GPR55 and GPR97 as targets of curcumin. Activation of GPR55 may be involved in the antidiabetic activity of curcumin by promoting GLP-1 secretion.

Keyword: curcumin, G protein-coupled receptor, glucagon-like peptide 1, type 2 diabetes, glucocorticoid

[*npj Sci Food*, 6, 4, 2022; *BBRC*, 595, 41-46, 2022]

Conflict of Interest Disclosure: The funder (House Wellness Foods Corporation) provided support in the form of salaries for an author (N.Y.), but did not have any role in the study design, data collection, and analysis.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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PAB(T7-40)
Lactate positively modulates skeletal muscle mass in mice regardless of loading condition

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Background and objectives: Lactate, one of molecules released from skeletal muscle cells, is suggested to contribute to muscle mass gain. It is shown that extracellular lactate increases C2C12 myotube diameter. Recently, it was reported that oral lactate administration stimulates muscle hypertrophy and injured muscle regeneration in mice. However, the effects of lactate on unloading-related atrophy and reloading-related regrowth of skeletal muscle remain unclear. In the present study, the effects of lactate on mechanical loading-related changes of skeletal muscle mass in mice were investigated.

Methods: All animal studies were carried out in accordance with the Guide for the Care and Use of Laboratory Animals by the National Institutes of Health and were approved by the Animal Use Committee of Toyohashi SOZO University. Male C57BL/6J mice, aged 8 weeks old were divided into (1) control, (2) lactate-administered, (3) unloaded, (4) unloaded with lactate-administered, (5) reloaded, and (6) reloaded with lactate-administered groups. Mice in the unloaded and reloaded groups were subjected to hindlimb suspension (HS) for 2 weeks and 2-week ambulation recovery after HS, respectively. Mice of the lactate-administered groups were orally administered sodium lactate (1,000 mg/kg body weight) 5 days per week. At the end of the experimental period, both plantaris and soleus muscles were dissected from both hindlimbs of mice. Isolated muscle tissues were weighed and stored until the later analyses. Phosphorylation level of AMPK in each muscle sample was evaluated.

Results: Oral administration of lactate increased the weight of mouse plantaris and soleus muscles. Unloading-associated atrophy of plantaris and soleus muscles was partially attenuated by lactate administration. Further, lactate administration stimulated the regrowth of atrophied plantaris muscle induced by unloading. Decrease in the phosphorylation level of AMPK in plantaris muscle was observed by lactate administration in spite of the loading condition.

Conclusions: Findings from the present study indicate that lactate stimulates skeletal muscle growth and suppresses unloading-associated skeletal muscle atrophy. Stimulating effects of lactate on muscle mass may be dependent on fiber type. This work was partially supported by JSPS KAKENHI (18K10796 and 21K11276).

Keyword: Lactate, skeletal muscle, hypertrophy, atrophy, regrowth

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T7-41)
Biological effects of oleanolic acid on lipolysis, antioxidative and mitochondrial activities in 3T3-L1 adipocytes

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Background and objectives: Oleanolic acid (OA), a natural triterpenoid found in various edible plants having anti-obesity and antioxidative activities, could be useful against obesity, a serious global public health problem. In the present study, to clarify these properties of OA and understand the underlying mechanisms, we examined its effects on lipolysis, antioxidative and mitochondrial activities in 3T3-L1 adipocytes.

Methods: Mouse 3T3-L1 preadipocytes were differentiated to matured adipocytes by culturing in DMEM + 10 % FBS, 10 µg/mL insulin, 250 nM dexamethasone, and 0.5 mM 3-isobutyl-1-methylxanthine for 3–4 days, and then in DMEM + 10 % FBS and 5 µg/mL insulin for the next 6 days. Lipolysis activity was evaluated by measuring the level of released glycerol in the medium from matured adipocytes treated with 50 µM OA. Antioxidative activity was assessed by measuring the oxidation of 2,7-dichlorofluorescein diacetate in matured 3T3-L1 cells pretreated for 48 h with 50 µM OA in the absence or presence of 10 µM zinc protoporphyrin-9, an inhibitor of heme oxygenase-1 (HO-1). The protein expressions and phosphorylation induced by OA were analyzed by Western blotting with cell lysates from matured adipocytes incubated for various times and with various concentrations of OA.

Results: OA induced lipolysis and phosphorylation of hormone-sensitive lipase (HSL) in 3T3-L1 adipocytes, which was blunted by a PKA inhibitor H-89. Furthermore, OA increased the expression of HO-1 and reduced intracellular oxidative stress. Treatment with HO-1 inhibitor suppressed the antioxidative effect of OA but did not affect its lipolytic activity. In addition, OA increased citrate synthase, a mitochondrial enzyme.

Conclusions: These results indicate that OA exerts lipolytic activity through the PKA pathway and possesses antioxidative properties. In addition, OA has a possible effect to modulate mitochondrial activity. These results suggest OA has a potential of a useful candidate for the treatment of obesity and its related oxidative stress.

Keyword: oleanolic acid, lipolysis, heme oxygenase-1, adipocyte, citrate synthase

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-42)
Dietary D-allulose reduces body fat accumulation in rats fed medium-chain triglyceride diets

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Background and objectives: D-Allulose (D-psicose) is a rare sugar, which contains zero calories and has 70% sweetness relative to sucrose. Recently, many studies have shown the anti-obesity effect of D-allulose by suppressing lipogenesis and increasing energy expenditure. Conversely, medium-chain triglycerides (MCT) are lipids formed by three medium-chain fatty acids with 6–12 carbon atoms attached to the glycerol. MCT has been studied for years in an attempt to reduce body fat accumulation in rats and humans. The anti-obesity effect of MCT was not confirmed depending on the nutritional conditions because MCT might promote lipogenesis. This study has investigated the effects of simultaneous intake of d-allulose and MCT on body fat accumulation in rats.

Methods: Exp. 1] Forty male Wistar rats (3 weeks old) were randomly divided into five groups. One group of rats was given a commercial diet, which is the control (C1) group. The remaining four groups were the LM, HM, LMA, and HMA groups, respectively. L, H, M, and A are abbreviations for low, high, MCT, and D-allulose, respectively [Exp. 2] Thirty-two male Wistar rats (3-week-old) were divided into four groups, the C2 (control), M, A, and MA groups, respectively. The LM, LMA, M, and MA diets contained 5% MCT, the HM and HMA diets contained 13% MCT, and the LMA, HMA, A, and MA diets contained 5% D-allulose. In each experiment, rats were fed with experimental diets *ad libitum* for 8 weeks, and then the rats were sacrificed.

Results: [Exp. 1] Intra-abdominal adipose tissue weights were significantly greater in the HM group than that in the C1 group. D-Allulose significantly decreased the weights of intra-abdominal adipose tissue, carcass fat, and total body fat, while these increased as the amount of MCT added increased. [Exp. 2] D-Allulose significantly decreased the weights of intra-abdominal adipose tissue, carcass fat, and total body fat, on the other hand, these were not influenced by the presence or absence of MCT addition.

Conclusion: The anti-obesity effect of D-allulose was observed with or without dietary MCT, but no synergistic effect between D-allulose and MCT has been observed.

Keyword: D-allulose, medium-chain triglycerides, body fat, rat

PAB(T7-43)
Postprandial blood glucose response of sponge cake intake containing resistant starch in healthy female university students

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Background and objectives: Resistant starch escapes digestion until reaching colon and acts like dietary fiber. Many studies have shown that consuming meals with high RS contents were lower postprandial blood glucose concentration compared with consuming ordinary meals. Western confectionary of sponge cakes are very popular, and are preferred to women than men in Japan. Sponge cakes contain a lot of sugar and fat, therefore, too much consumption of these could lead to overweight, obesity and non-communicable diseases. Amylofiber®SH (AF-SH) is derived from high amylose corn starch and contains 68% of RS which was measured by AOAC method 2002.02. In this study, we baked sponge cakes using AF-SH, kindly provided from J-OIL MILLS, INC., and evaluated the postprandial blood glucose of healthy female university students when they consumed AF-SH sponge cake.

Methods: This study was a single-arm design. The difference of ingredient between standard sponge cake and AF-SH sponge cake was using wheat flour or 100% AF-SH. Nine volunteers of female students, aged 20-23 years, were participated in this study. During study period, subjects could consumed foods and drinks freely. The day before the experiment, they fasted after dinner until the experiment began. Subjects were given standard sponge cake first, then were given the AF-SH sponge cake a week later. Using self-monitoring blood glucose equipment (NIPRO TRUEpico®), subjects measured by themselves of peripheral blood glucose levels at 0, 15, 30, 60, 90, 120 minutes after standard sponge cake intake or AF-SH sponge cake intake.

Results: The consumption of AF-SH sponge cake resulted in a significant reduction in postprandial blood glucose incremental area under curve from 0 to 120 minutes compared with that of standard sponge cake ($p<0.05$).

Conclusions: This study demonstrated that sponge cake made from high amylose corn starch contained of 68% RS reduced postprandial blood glucose compared to standard sponge cake, therefore, it might be helpful for glycemic control for healthy people.

Keyword: Resistant starch, Sponge cake, Postprandial blood glucose, University female students

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-44)
Development of Glucagon-Like Peptide-1 Sandwich ELISAs and Their Application for the Effects of Black Tea Polyphenols in STC-1 Cells.

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Background and objectives: Glucagon-like peptide-1 (GLP-1) is one of the incretin hormones and plays an important role in the metabolic response. GLP-1 is secreted in its active form but is rapidly degraded by the dipeptidyl peptidase-4, converting >90% to the inactive metabolite before reaching the target organs via circulation. Therefore, promoting endogenous GLP-1 secretion is a good strategy for diabetes treatment. It has been reported that various nutrients stimulate GLP-1 secretion. However, whether non-nutrients, including black tea polyphenols, possess properties for the secretion of GLP-1 is not yet fully understood. The ability to identify the effective plant bioactive compound is severely limited by the high cost of commercial assays. Thus, we aimed to 1) develop a cost-effective sandwich ELISAs (s-ELISAs) for detecting the 'active' and 'total' GLP-1 and 2) apply the s-ELISAs to investigate the effects of black tea polyphenols in STC-1 cells, and elucidate their secretory mechanisms.

Methods: To develop the s-ELISAs, all antibodies used recognized different GLP-1 epitopes and were optimized by the checkerboard titration method. GLP-1 secretion studies were conducted in STC-1 cells. The molecular mechanism of the bioactive compounds was examined by Western blot and immunofluorescence microscopy analysis.

Results and Conclusion: Three s-ELISAs were developed; total, sensitive active, and wide-range active GLP-1 ELISAs. The s-ELISAs exhibited high sensitivity; dynamic ranges between 1.62 ~ 240, 1.40 ~ 62.5, and 8.3 ~ 4480 pmol/L, respectively. High precision was observed; i.e., CVs within 5% and 20% for intra- and inter-assay variations, respectively, and excellent recoveries, with the same performance as the commercial kits. Cinnamtannin A2-induced GLP-1 secretion was confirmed by the developed s-ELISAs as consistent with our previous findings, indicating that the developed s-ELISAs were applicable for the measurement of GLP-1. Using these s-ELISAs, we found that theaflavins (TFs) in black tea polyphenol extract, in particular TF1 and TF2B, significantly increased both active and total GLP-1 levels. As for the secretory mechanism, TFs induced GLP-1 secretion via the Ca^{2+}/CaMKII pathway through MEK-ERK1/2 signaling. Therefore, we successfully developed the new GLP-1 s-ELISAs and demonstrated the novel function of TFs in regards to GLP-1 secretion.

Keyword: Glucagon-like peptide-1 (GLP-1), Theaflavins, Functional Foods, Black tea polyphenols, Immunoassay

PAB(T7-45)
The influences of biofilm formation on Myoga (Zingiber myoga) extraction.

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Objectives: Dental caries have become a major global health problem. Patients may experience difficulties chewing when dental caries becomes severe; thus, oral care is important to maintain a high quality of life. *Streptococcus mutans* and *S. sobrinus* are etiologic agents of human dental caries, as they form biofilm that progresses the formation of cavities, and controlling biofilm production prevents dental caries. It has been reported that Zingiberaceae plants, such as myoga, cinnamon, and ginger, contain a stable antibacterial substance. In this study, we extracted components from myoga using hexane, ethyl acetate, and methanol, and examined their effects on biofilm formation.

Methods: Hexane was added to freeze-dried myoga, and the mixture was left for 24 hours and filtered. Ethyl acetate was added to the filtration residue, and the mixture was filtered, and finally, methanol was added to the filtration residue. The solvents were removed from each extract. *S.mutans* or *S.sobrinus* was added to a liquid medium containing sucrose. Thereafter, the hexane, ethyl acetate, and methanol extracts from myoga were added at different concentrations. After culturing for 24 hours, biofilm formation was examined using a crystal violet assay.

Result and consideration: Biofilm formation by *S. mutans* and *S. sobrinus* was suppressed at lower concentrations with methanol extract. Ethyl acetate extract suppressed biofilm formation by *S. mutans* and *S. sobrinus*, as the concentration decreased. However, hexane extract suppressed biofilm formation by *S. mutans* at lower concentrations, and biofilm formation by *S. sobrinus* at higher concentrations. Therefore, methanol and ethyl acetate extracts with low concentration were effective for suppressing biofilm formation by both *S. mutans* and *S. sobrinus*.

Keyword: myoga, Streptococcus mutans, Streptococcus sobrinus, antibacteial activity, biofilm formation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-46)
Analysis of antioxidative polyphenols from Virgin moringa leaves

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Background and objectives: *Moringa oleifera* is harvested in many tropical countries. The plant leaves, seeds, bark, roots, sap, and flowers are widely used to treat many ailments, including inflammation-related and infectious diseases, and cardiovascular, gastrointestinal, hematological, and hepatorenal disorders. We cultivated moringa in Amakusa, Japan, and successfully developed a functional food product, namely "Virgin moringa leaf" (VML). In this study, we tried to find which part of moringa contains the most abundant antioxidants. Furthermore, we focused on the identification and characterization of individual antioxidative polyphenols.

Methods: Moringa leaves harvested in Japan, India, and Brazil and VML were air-dried, ground to powder, and extracted by mixing with hot water. Various parts of moringa in Japan, such as leaves, flowers, roots, stems, and seeds were also extracted with hot water. Antioxidative activity was estimated from the DPPH radical-scavenging activity. Online HPLC-DPPH screening method, a real-time HPLC coupled to the DPPH assay, was performed for evaluation of radical scavenging polyphenols in VML. Liquid chromatography-time-of-flight/mass spectrometry (LC-TOF/MS) was used for the identification and characterization of antioxidative compounds.

Results: In comparison with leaves from Japan, India, and Brazil, VML yielded the highest antioxidative activities and polyphenol contents. Leaves and flowers exhibited the highest antioxidative activities and polyphenol contents among the various parts of moringa. Four compounds matching with high antioxidant activities were detected in VML on the chart of online HPLC-DPPH screening method. Two of the compounds from the respective MS peak in negative ion mode and retention time were identified 3-*O*-caffeoylquinic acid (3-CQA, *m/z* 353.0901) and 5-*O*-caffeoylquinic acid (chlorogenic acid, 5-CQA, *m/z* 353.0845), respectively, and were the most potent quenchers of DPPH radical. While there was no difference between the amounts of 3-CQA and 5-CQA in VML, trolox equivalent antioxidant capacity (TEAC) of 3-CQA was 1.3 hold higher than that of 5-CQA. Contribution rate of 3-CQA to the antioxidative activity of VML was also 1.3 hold higher than that of 5-CQA. The other two compounds (*m/z* 463.0863 and *m/z* 549.0849) were estimated as quercetin glycosides.

Conclusions: 3-CQA and 5-CQA in VML have pronounced antioxidant activities. VML is a promising functional food product.

Keyword: moringa leaf, antioxidants, chlorogenic acid, polyphenols, online HPLC-DPPH screening method

PAB(T7-47)
Ameliorating Effect of Cinnamon Extracts Dietary Supplementation on Serum and Hepatic Lipid Profiles in High-Fat-Diet induced Obese Mice Model

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Background and Objectives: The previous research has identified that the Cinnamon extracts has an excellent anti-obese effects among traditional medicine. Also, Cinnamon has been known for modulating several metabolic disorders by regulating insulin sensitivity. This study aimed to investigate the ameliorating effects of cinnamon extracts on serum and hepatic lipid profiles in high-fat-diet induced obese mice model.

Methods: After 1 week of acclimation, the 6-week-old male C57BL/6J mice were randomly divided into 4 groups of 10 mice each (n=10 for each group): normal diet group (ND), normal diet with 1% cinnamon extracts (NC), high-fat-diet group (HF), and high-fat diet with 1% cinnamon extracts (HC). All groups were treated with respective diet for 14 weeks.

Results: Serum TG (Triglyceride) levels and TC (Total cholesterol) levels were higher in HF group than other 3 groups (P=0.000); HC group presented significantly decreased levels compared to that of HF group (P=0.000). Hepatic TG and TC levels were higher in HF group than other 3 groups (P<0.05); HC group showed significantly decreased levels compared to that of HF group(P=0.008).

Conclusions: The present data showed Cinnamon Extracts may have the ameliorating function in vivo by reducing the elevated lipids (TG and TC) levels, especially in high-fat-diet induced model. The further analysis of protein expression of related enzymes and tissue factors are in progress.

Keyword: Cinnamon Extracts, Anti-Obese, Lipid profiles, Triglyceride(TG), Total cholesterol(TC)

Conflict of Interest Disclosure: The Authors declare there is no conlict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-48)

Daily maslinic acid intake combined with physical exercise improves muscle strength and muscle mass in healthy adults: a randomized, double-blind, two-dose placebo-controlled trial

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Background and objectives: Age-related changes in physical function are closely related to the impairment of daily activities among the elderly. Although continuous maslinic acid (MA) intake may improve skeletal muscle mass, the concentration-dependent benefits of MA for food functionality are yet to be clarified. We hypothesized that differences in MA absorption in the blood resulting from variations in MA intake improve muscle mass and strength. Herein, we evaluated the difference in blood MA absorption at different MA intake levels and examined the effect of MA intake on skeletal muscle and quality of life in healthy adults.

Methods: In experiment 1, five healthy adult men were administered test diets containing 30, 60, or 120 mg of MA in a single-blind crossover trial, and the plasma MA content was analyzed before and 0.5, 1, 2, 3, 4, 8, 12, and 24 h after test diet ingestion. In experiment 2, 69 healthy adults were administered a placebo or 30 or 60 mg MA continuously for 12 weeks with physical exercise in a randomized, double-blind, two-dose placebo-controlled trial. Before and after the intervention, we assessed body composition, grip strength, leg strength, walking speed, and QOL score.

Results: In experiment 1, the MA concentration peaked at approximately 3 h after administration. A concentration-dependent increase in the blood MA level was observed ($p < 0.01$). In experiment 2, the trunk muscle mass ($p < 0.05$) and vitality score according to the Short Form-8 ($p < 0.05$) were significantly higher in the 60 mg MA group than in the placebo group. In addition, the grip strength significantly increased in the 30 mg ($p < 0.05$) and 60 mg ($p < 0.05$) groups than in the placebo group.

Conclusions: These results could suggest that the combination of MA intake and physical exercise improved muscle strength, and the muscle mass and quality of life improved in a MA-intake-dependent manner.

Keyword: maslinic acid, muscle strength, muscle mass, sarcopenia

PAB(T7-49)

Oleuropein Aglycone Enhances UCP1 Expression in Brown Adipose Tissue in High-Fat-Diet-Induced Obese Rats by Activating β-Adrenergic Signalling

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Oleuropein is the pungent principle of raw olives. Oleuropein aglycone (OA) is a major phenolic compound in extra virgin olive oil and the absorbed form of oleuropein. We aimed to determine the mechanism underlying the nutritional effects of oleuropein and OA on interscapular brown adipose tissue (IBAT) in rats with high-fat (HF) diet-induced obesity by examining the agonistic activity of oleuropein and OA toward the transient receptor potential ankyrin 1 (TRPA1) and vanilloid 1 (TRPV1). Four-week-old-male Sprague-Dawley rats were fed a HF (palm oil 30% wt:wt) diet alone or with oleuropein (HF-O, 1 g/kg diet) for 28 d. In rats fed HF-O compared to HF, urinary noradrenaline, adrenaline and UCP1 levels in IBAT were significantly higher, whereas plasma leptin levels and the total weight of the abdominal cavity adipose tissue were significantly lower. In anesthetized 7-wk-old -male Sprague-Dawley rats, the OA (3.8 mg of intravenous injection)-induced increase in plasma noradrenaline secretion was suppressed byTRPA1 or TRPV1 antagonist and by a β2- or β3-adrenoceptor antagonist. Furthermore, OA activated rat and human TRPV1s expressed on HEK293 cells at the same level as zingerone (pungent component in ginger). OA also activated humanTRPA1 and its potency was approximately 10-fold stronger than that for TRPV1. These findings suggest that OA is the agonist of both TRPA1 and TRPV1 and that OA enhances UCP1 expression in IBAT with a concomitant decrease in the visceral fat mass of HF diet-induced obese rats through enhanced noradrenaline secretion via β-adrenergic action following TRPA1 and TRPV1 activation.

Keyword: Brown adipose tissue, Noradrenaline, Oleuropein aglycone, TRPA1, TRPV1

Conflict of Interest Disclosure: No conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-50)
The milk casein hydrolysate-derived peptide enhances glucose uptake through AMP-activated protein kinase signaling pathway in C2C12 skeletal muscle cells

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Background and objectives: Improvement of glucose metabolism in skeletal muscle has a key role in physical performance and prevention of metabolic diseases. Previously, we have shown that intake of milk casein hydrolysate improves glucose metabolism in humans, but the mechanism of action is unclear. In this study, we aimed to investigate the mechanism of action of milk casein hydrolysate and its derived peptides (valine-proline-proline and isoleucine-proline-proline) on glucose metabolism by focusing on the insulin-dependent and insulin-independent signaling pathways in cultured skeletal muscle cells.

Methods: C2C12 myoblasts were differentiated for 96 h after growth until the cells achieved confluence, and the confluent cells were used in each experiment. Experiments using milk casein hydrolysate, valine-proline-proline, and isoleucine-proline-proline were carried out after 4-hour incubations in unsupplemented medium. Subsequently, the rate of 2-deoxy-glucose uptake and phosphorylation levels of insulin-dependent and -independent signaling factors were examined.

Results: The rate of 2-deoxy-glucose uptake in both milk casein hydrolysate and isoleucine-proline-proline-treated cells was higher than that in the control cells ($P < 0.01$). Immunoblotting assays showed that the phosphorylation levels of AMP-activated protein kinase, a rate-limiting factor in insulin-independent signaling, and that of liver kinase B1, an upstream factor of AMP-activated protein kinase, in both milk casein hydrolysate and isoleucine-proline-proline-treated cells were higher than those in the control cells ($P < 0.05$). Such significant effects were not observed after treatment with valine-proline-proline. The insulin-dependent signaling was not significantly affected by either milk casein hydrolysate or the peptides.

Conclusions: The findings of our study suggest that milk casein hydrolysate enhances glucose uptake by activating insulin-independent AMP-activated protein kinase signaling in skeletal muscle cells, which might be mediated by a milk casein hydrolysate-derived peptide, isoleucine-proline-proline. These observations suggest potential for mechanism of metabolic improvement induced by milk casein hydrolysate in humans.

Keyword: Glucose metabolism, AMP-activated protein kinase, Skeletal muscle cell

PAB(T7-51)
Involvement of circadian rhythm on luteolin-induced antioxidant enzymes through Nrf2 activation in hepatocytes

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Background and objectives: Luteolin has various health-promoting activities. It has been reported that high dose of luteolin activates the Nrf2/ARE pathway in the liver. However, an intake amount of luteolin and its glycosides from a dietary meal is limited. In this study, we investigated the effect of the low dose range of luteolin on the induction of antioxidant enzymes and its molecular mechanism in HepG2 cells. We also investigated whether an administration timing affects the induction of antioxidant enzymes in ICR mice.

Methods: HepG2 cells were treated with luteolin at 0.01 nM-1 μM for 24 h. Activation of Nrf2/ARE pathway was examined by an electrophoretic mobility shift assay. Nuclear accumulation of Nrf2 and the expression of antioxidant enzymes were determined by western blot. U0126 and PD98059 were used as MEK inhibitors. Mice were orally administered luteolin at 0.01-10 mg/kg body weight/day for 7 consecutive days at the beginning of inactive phase and that of active one. Plasma concentration of luteolin was determined by HPLC.

Results: Luteolin at 1 nM significantly induced antioxidant enzymes, namely NQO1, HO-1 and AKR1B10, in HepG2 cells accompanied by phosphorylation and nuclear accumulation of Nrf2 and binding of Nrf2 to ARE. MEK inhibitors cancelled both phosphorylation and transcriptional activity of Nrf2. Oral administration of luteolin at 0.1-10 mg/kg body weight increased expression of NQO1 and HO-1, and nuclear accumulation of Nrf2 in the liver at the beginning of active phase, but not that of inactive one. The plasma concentration of luteolin aglycon was higher in the beginning of active phase than in that of inactive one.

Conclusion: These results indicated that low dose of luteolin increased antioxidant enzymes through the ERK1/2-mediated Nrf2/ARE pathway. There existed a suitable administration timing to reveal this beneficial function of luteolin depending on difference of the level of aglycon form of luteolin in plasma. In conclusion, a dietary level of luteolin-induced antioxidant enzymes and this function may contribute to prevent many diseases through suppression of oxidative stress in the liver. This work was supported by JSPS KAKENHI 17H0818.

Keyword: Luteolin, Nrf2, antioxidant enzymes, ERK1/2, circadian rhythm

Conflict of Interest Disclosure: There are no conflicts to declare.

PAB(T7-52)
Clitoria ternatea flower extract suppresses postprandial lipemia and improves antioxidant status induced by a high-fat meal in overweigh/obese subjects

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Background and Objective: High-fat (HF) meal-induced postprandial lipemia, oxidative stress and low-grade inflammation, contributing to an increased risk of metabolic disorders. *Clitoria ternatea* L. or butterfly pea is a natural food source of phytochemical compounds, especially anthocyanins. The pharmacological properties of *C. ternatea* has been revealed as antioxidant, anti-hyperlipidemic, and anti-inflammatory effects. The aim of this study was to investigate the effect of *C. ternatea* L. flower extract (CTE) on postprandial lipemia, antioxidant status, and inflammatory response following high-fat meal consumption in overweight/obese men.

Methods: In randomized, crossover, control trial study, sixteen overweight/obese men (body mass index, 25.7 ± 0.7 kg/m^2) were assigned to three groups that consumed HF meal or HF with 1 or 2 g CTE in the beverage. Blood samples were collected at fasting state and then at 30, 60, 90, 120, 180, 240, 300 and 360 min after the meal consumption.

Results: Phenolic and anthocyanins content of CTE were 50.19 ± 0.86 mg gallic acid equivalent and 0.87 ± 0.13 mg delphinidin-3-glucoside equivalents/g dried extract, respectively. DPPH radical scavenging activity and the ferric reducing antioxidant power of CTE were 18.64 ± 3.07 µg ascorbic acid equivalent and 0.32 ± 0.01 mM $FeSO_4$ equivalent/mg extract, respectively. The ingestion of CTE (2 g) significant decreased the incremental area under the curve (iAUC) of postprandial serum triglyceride and the level of serum free fatty acid (FFA) at 360 min following HF-meal consumption. Postprandial plasma antioxidant capacity presented by ferric reducing ability of plasma and protein thiol was significantly increased after consumption of HF meal plus CTE, corresponding to the improvement of glutathione peroxidase activity. In consistence, CTE consumption also decreased the elevated plasma lipid peroxidation product, malondialdehyde, after administration HF meal. However, no significant difference was observed for the level of serum inflammatory cytokines (interleulin-6, interleulin-1β and tumor necrosis factor-α) and the expression of interleulin-6 and interleulin-1β genes in peripheral blood mononuclear cells response to HF consumption among three groups.

Conclusion: These findings suggest that acute ingestion of CTE may improve postprandial lipemia and antioxidant status when consumed with HF meal in overweight/obese subjects.

Keyword: Clitoria ternatea, Anthocyanins, High-fat meal, Postprandial lipemia, Antioxidant status

Conflict of Interest Disclosure: The authors declare that they have no competing interests.

PAB(T7-53)
Effects of heat killed *Bifidobacterium* on anti-obesity

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Backgraound and objectives: Obesity is a serious health problem worldwide. It is reported that gut microflora is a contributing factor for the leading or protection of obesity. *Bifidobacteria* are colonize the human gastrointestinal tract and *Bifidobacterium* species are known to have beneficial health effects on human physiology and pathology, such as immunomodulation. These effects have led to use of *Bifidobacteria* as components of probiotics products. *Bifidobacterium* species produce acetic acid as a final metabolite, but the level of production is different among the species and/or depending on living or dead cells. It has been indicated that supplementation of acetic acid has an effect on improving obesity, lipid accumulation in the liver, or glucose tolerance. In addition, in our recent study, long-term supplementation of one of *Bifidobacterium* species had the effect on improving obesity. In this study, we investigated the efffect of heat killed *Bifidobacterium* cells on energy metabolism and prevention of obesity.

Methods: *Bifidobacterium* isolated from infant feces were heat killed and suspended into 12% (w/w) skimmed milk. Each suspension was administered to Otsuka Long-Evans Tokushima Fatty (OLETF) rats, which are type 2 diabetes model animals that develop obesity and diabetes due to overeating, at 5 mL / kg of body weight for 5 days per week from 7 to 15 weeks of age. Food consumption and body weight of each rat were recorded every day. At 16 weeks of age, the rats were anesthetized, dissected, isolated muscles, liver, and white adipose tissues, and those tissues were used for subsequent experiments.

Results: The weight gain and food efficiency were suppressed significantly in the rats administered heat killed *Bifidobacteria* as compared with rats administered water, and lipid accumulation in the liver was also inhibited in heat killed *Bifidobacteria* group as compared with water group. Furthermore, the gene expression of mitochondria-related in soleus were significantly higher in the rats administered heat killed *Bifidobacteria* than rats administered water.

Conclusions: It is suggested that heat killed *Bifidobacterium* cells may have similar effect to living cells.

Keyword: Bifidobacterium, obesity, acetic acid

PAB(T7-54)

Oligosaccharides from agar extends lifespan through the activations of unfolded protein response and IIS pathway in *Caenorhabditis elegans*

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Background and objectives: Agarose, the main component of polysaccharides in agar, comprises of D-galactose and 3,6-anhydro-L-galactose. The α1-3 bond is easily hydrolyzed to produce agaro-oligosaccharides (AGO) with repeating agarobiose units composed of D-galactose at the non-reducing end and 3,6-anhydro-L-galactose at the reducing end. AGO exhibits various physiological activities including antioxidative and antiinflammation activities. Because the cumulative oxidative stress and chronic inflammation are involved in the physiological ageing process, we speculated that AGO is effective in preventing ageing. The aim of this study is to evaluate the effect of AGO on lifespan extension and to elucidate the mechanism of AGO-mediated longevity in *Caenorhabditis elegans* (*C. elegans*).

Methods: Young adult worms were placed on nematode growth medium plates containing AGO, fructooligosaccharides (FOS), isomalto-oligosaccharides (IMO), or polydextrose (PDX). The mean lifespan, body size, brood size, locomotory activity, lipofuscin accumulation, and heat stress resistance of worms were examined. To elucidate mechanisms of AGO-mediated longevity, we conducted comprehensive expression analysis using microarrays. We used quantitative real-time PCR (qRT-PCR) to verify the genes showing differential expression levels. Furthermore, we measured the lifespan of mutant worms to determine the genes related to AGO-mediated longevity.

Results: The lifespans of the worms fed AGO, but not FOS, IMO, or PDX, were significantly longer than control group. The growth curves of worms and brood sizes were similar to control group. The worms fed AGO displayed higher locomotion and lower lipofuscin accumulation. The microarray analysis revealed that the endoplasmic reticulum-unfolded protein response (ER-UPR) and insulin/insulin-like growth factor-1-mediated signaling (IIS) pathway were activated in worms fed AGO. Results of the qRT-PCR analyses, AGO treatment suppressed *sir-2.1* expression, which is a negative regulator of the ER-UPR, and increased *abu/pqn* families of genes downstream of *sir-2.1.* In the heat condition, the mean survival time of the worms fed AGO was significantly longer than control group. AGO-induced longevity and heat stress resistance were decreased or cancelled completely in the *sir-2.1* mutant. Furthermore, the AGO-mediated longevity was decreased in mutants of *daf-2* and *daf-16*, which are IIS pathway-related genes.

Conclusions: AGO extended the lifespan of *C. elegans* through the activations of ER-UPR and the IIS pathway.

Keyword: C. elegans, Healthspan, Longevity, Nematode, Oligosaccharide

PAB(T7-55)

The effects of prebiotics intervention on gut microbiota and short chain fatty acid in healthy adults: a systematic review and meta-analysis

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Background and objectives: Gut microbiota can be affected by genetic, western diet, poor lifestyle, stress and aging, and cause the dysbiosis. Dysbiosis have already been implicated in multiple diseases such as metabolic syndrome, obesity, and diabetes, while recent search suggests a potential role of the microbiota-gut-brain axis in neuropsychiatric disorders, such as cognitive deficit disorders and depression. Diet is one of the major factor to modify the gut microbiota composition, and prebiotics supplementation may increase specific bacterial numbers and metabolites, including short-chain fatty acid (SCFA). In this study, a systematic review and meta-analysis were undertaken to assess the effect of prebiotics intervention on gut microbiota and SCFA in healthy adults.

Methods: A systematic search was conducted including Cochrane library, EMBASE, and Pubmed for these inclusive criteria: (1) randomized controlled trials; (2) healthy adults aged 18-65 yr; (3) prebiotics intervention compare to placebo or no supplement; (4) using culture and/or molecular microbiological techniques and mass spectrometric techniques; (5) major outcome were gut microbiota composition and/or metabolites SCFA. Meta-analyses via a random-effects model were performed on specified bacterial abundances including *Bifidobacterium, Lactobacillus, Clostridium, Bacteroides* and fecal SCFA concentrations comparing prebiotics interventions with placebo comparators.

Results: Twenty two independent studies involving 810 healthy adults were included in the present meta-analysis. Prebiotics intervention resulted in higher abundance of *Bifidobacterium* (standardized mean difference (SMD): 0.72; 95% CI: 0.32, 1.10) compared with placebo/ no supplement comparators. No differences in effect were found between prebiotics intervention and comparators for abundances of other bacteria, or all SCFA concentrations.

Conclusions: The present meta-analysis shows that prebiotics interventions, involving xylo-oligosaccharide (XOS) , inulin, fructans, and partially hydrolyzed guar gum, lead to a higher abundance of *Bifidobacterium*, but other bacteria and fecal SCFA show no trend.

Keyword: Prebiotics, Gut microbiota, Short chain fatty acid, Bifidobacterium, Meta analysis

Further Collaborators: Shyh Hsiang Lin

PAB(T7-56)
Tryptophan microbial metabolites play a key role in fermented rice bran function in preventing DSS-induced colitis

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Background and objectives: Supplementation of rice bran (RB) which has been fermented with *Aspergillus kawachii* and a mixture of lactic acid bacteria (FRB) has been shown to induce some health benefits, such as improving the blood pressure, lipid profile, and glucose metabolism in stroke-prone hypertensive rats. It was also able to prevent muscle waste in streptozotocin-induced diabetic rats. In this study, we evaluated the effect of FRB supplementation in mitigating dextran sodium sulfate (DSS)-induced colitis. An investigation over which fermented rice bran bioactive compounds play a key role in this colitis-preventing effect was also conducted.

Methods: Male C57BL/6N mice were divided into three groups. One group was provided with a control diet, another was fed with a 10% RB supplemented diet, and the remaining group was given a 10% FRB supplemented diet. The diet treatment was started 4 days before colitis was induced. Colitis was induced by dextran sodium sulfate (DSS) treatment for 12 consecutive days. Moreover, FRB was separated into several different fractions and its anti-inflammatory activity was evaluated with lipopolysaccharide (LPS)-stimulated RAW 264.7 cells. FRB fractions, along with mice serum and fecal contents, were analyzed for their bioactive compounds.

Results: DSS treatment caused severe body weight loss and mucosal inflammation in the control and RB group, but not in the FRB group. FRB also markedly decreased mRNA levels of pro-inflammatory cytokines in mice colons. On the other hand, FRB fractions which were rich in tryptophan and tryptamine were able to reduce the inflammatory markers in LPS-stimulated RAW 264.7 cells. The presence of tryptophan and tryptophan metabolites in mice feces and serum were also increased in mice fed FRB and might serve as a confirmation that tryptophan metabolites in FRB played a key role in FRB's colitis preventive effect.

Conclusions: Tryptophan metabolites, especially tryptamine, might have played a key role in FRB's protective effect against DSS-induced inflammation in mice. This effect might have been achieved due to tryptophan metabolites' ability to act as a ligand to aryl hydrocarbon receptor.

Keyword: dextran sodium sulfate, fermented rice bran, inflammation, tryptamine, tryptophan

PAB(T7-57)
Functional evaluation of *Clostridium isatidis* related bacteria in high-fat diet-induced obese mice

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Background and Objectives: Thermophile-fermented compost is an agricultural material produced by the fermentation of unutilized marine resources under high temperature and aerobic conditions. Previous studies have shown that the administration of the compost has beneficial effects such as lowering the disease incidence and promoting the growth of piglets. It has also been reported that *Bacillus hisashii* N-11^T strain identified from the cecal feces of gnotobiotic mice fed with thermophile-fermented compost reduces the accumulation of visceral fat in mice and pigs. In addition, a bacterium that is closely relative to *Clostridium. isatidis* have also been isolated from the cecal feces, but their biological function has not been evaluated. In this study, we investigated the effect of *C. isatidis*. on high-fat diet-induced obese mice.

Methods: Five-week-old male C57BL/6J mice were fed with a normal-fat diet (NFD) or a 60% kcal high-fat diet (HFD). Mice of each diet group were received one of the following doses of *C. isatidis*. in drinking water; 0 (control), 5.0×10^2 (low), or 1.0×10^8 (high) cfu/mouse/day. After performing oral glucose tolerance test (OGTT), mice were sacrificed at the 17th week.

Results: Body weight gain was significantly decreased under NFD and tended to be decreased under HFD by *C. isatidis*. Plasma glucose level during OGTT performed to evaluate glucose metabolism tended to be reduced by *C. isatidis*. under both diets. In addition, plasma insulin level during OGTT was significantly decreased by a high amount of *C. isatidis*. under HFD. Furthermore, the exposure significantly decreased triglyceride level in the liver under HFD.

Conclusion: These results suggested that *C. isatidis*. could improve abnormal glucose and lipid metabolism induced by a high-fat diet.

Keyword: thermophile-fermented compost, Clostridium isatidis-related bacteria, glucose and lipid metabolism, obesity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-58)
Simultaneous detection of food compounds by a graphite carbon black-aided laser desorption ionization-mass spectrometry

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Background and objectives: Conventional analytical methods for the assay of functional and nutritional compounds, such as polyphenols, vitamins, amino acids, etc., require tedious sample preparation prior to analysis. For example, hydrophobic vitamins are extracted with organic solvent, while hydrophilic ones are extracted with polar aqueous solvent, when vitamins are analyzed liquid chromatography< LC>. In contrast, a laser desorption ionization-mass spectrometry is a powerful analytical technique for simultaneous detection of compounds without sample extraction and purification. Thus, the aim of the present study was to establish a simple analytical method for simultaneous detection of food compounds by an advanced LDI−MS using a graphite carbon black , since it possesses non−targeted adsorption property for diverse analytical targets and high thermal conductivity for UV laser irradiation.

Methods: Target compounds were dissolved in MS−grade water at each 10 mM concentration. GCB was suspended <2.5 mg/mL> in 50% 2−propanol, dropped onto an ITO-coated glass slide <2 µL/spot>, and air-dried. An aliquot <2 µL> of sample solution was dropped onto the GCB-spotted ITO glass slide and subjected to an LDI−MS analysis.

Results: GCB−aided LDI−MS measurement achieved the detection of all targets at negligible noise signals at 100−400 *m/z* in positive and negative ion modes for a few seconds. For the detection of amino acids by the LDI−MS, 11 amino acids except for Cys were detected in positive ionization mode without any interference with noise signals. In contrast, the measurement in negative ionization mode allowed the detection of all the target amino acids. This indicates that the present GCB−LDI−MS analysis can be assayed for a variety of amino acids in terms of *m/z* value. The GCB−aided LDI−MS was also applicable for simultaneous detection of nutrients in commercially available sports drink, containing hydrophobic vitamin A, hydrophilic vitamins B1, B2, B6, niacin, cystine, Val, Leu, and Gln.

Conclusions: This study demonstrated that the established GCB−aided LDI−MS is a novel food analytical method to measure a variety of food compounds, by its rapid, comprehensive, and convenient advantages.

Keyword: Food analysis, Graphite carbon black, Mass spectrometry, food compounds

PAB(T7-59)
Effects of Matcha Green Tea Consumption on Dynamic Visions (a Randomized Double-Blind Human Trial)

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Background and objectives: Lutein is an abundant pigment in the macula, and its dietary intake is suggested to improve sight contrast and may have protective effects against pigmentary degeneration of retina. Matcha green tea is rich in lutein, however, the information on efficacy of matcha on visual properties is limited. This study was aimed to clarify the effects of matcha green tea consumption on dynamic vision in healthy humans.

Methods: A randomized double-blind controlled trial was conducted on 31 female university students aged 20–22 years (16 in the matcha group as a test group; 15 in the barley tea group as a control group). The subjects consumed either test drink containing 3 g/day of matcha green tea powder, or the same amount of control drink containing 3 g/day of barley tea powder for 3 months. Dynamic visual acuity and eye movement were measured using ArrowZeye (Japan Sports Science Inc.), a PC software, before and after the intervention. The score was calculated at rank number, 1 to 10, plus correct response ratio (0.0 to 0.9) at their highest speed rank. A rank had 15 sets of measurements, and the speed increased when subjects earned at least 90% correct responses at the rank. Lutein intake was calculated using the Japanese database on carotenoid contents (Fukushima et al., 2021).

Results: In the test group, eye movement score significantly increased from 1.73 [1.60–1.80] to 1.80 [1.73-2.68] after intervention ($p<0.05$). In the control group, there was no changes. There were no differences between two groups in the eye movement before and after intervention. There were no significant changes for both groups in the dynamic visual acuity. Basal daily intake of lutein was 0.98[0.72–2.25] mg from the test group and 0.84[0.69–1.99] mg from the control group, where matcha consumption increase lutein intake at 2 mg/day during intervention in the test group.

Conclusions: The results suggest that consuming 3 g/day of matcha green tea for 3 months, provided about 3 times higher daily intake of lutein, effects eye movement in healthy humans.

Keyword: matcha green tea, lutein, dynamic vision, Japanese

Conflict of Interest Disclosure: This study was financially supported by a private fund, Matcha and Health Research.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-60)

The suppressive effect of rice-albumin hydrolysates on postprandial hyperglycemia on glucose loading.

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Background and objectives: Diabetes mellitus is one of the most severe diseases because it may lead to various complications. For the prevention of diabetes mellitus, it is effective to suppress or retard the increase in postprandial blood glucose level. We reported that oral administration of rice albumin (RA) suppressed blood glucose elevation not only on starch loading but also on glucose loading. Although RA did not inhibit the activity of mammalian α-amylase, the intraperitoneal glucose tolerance test (IPGTT) suggested that RA and its hydrolysates would act in the gastrointestinal tract. In addition, both indigestible high-molecular-weight peptides (HMP) and low-molecular-weight peptides (LMP) produced from RA by digestive enzymes suppressed the elevation of blood glucose level. However, the mechanism of the suppressive effect of HMP and LMP has not been clarified yet. As RA was shown to adsorb glucose similar to dietary fiber in our previous study, HMP may be responsible for the adsorption and promote glucose excretion. On the other hand, as LMP is too small to adsorb glucose, the possible mechanism would be the inhibition of glucose-transporter expression. Therefore, in this study, we examined if indigestible HMP would adsorb glucose to the same level as RA and LMP would inhibit the expression of sodium-dependent glucose transporter 1 (SGLT1).

Methods: The glucose-adsorption capacity of HMP was evaluated by measuring the glucose diffusion rate from the mixture of HMP and glucose through the dialysis membrane and compared the results with that of carboxymethyl cellulose (CMC). The effect of LMP on SGLT1 expression was investigated by using the intestinal secretin tumor cell line (STC-1) derived from mouse small intestinal epithelium. The SGLT1 expression level was evaluated with and without the addition of LMP to STC-1 by Western blotting.

Results: The suppressive effect of HMP on glucose diffusion was slightly lower than that of RA, and comparable to that of CMC. LMP suppressed the expression of SGLT1 in STC-1 cells.

Conclusions: The suppressive effect of RA on blood-glucose level would be attributed both to the glucose-adsorption capacity of HMP and to the inhibitory activity of LMP against SGLT1 expression.

Keyword: Rice albumin peptides, Rice protein, Blood glucose

PAB(T7-61)

Effects of matcha on lipid metabolism, oxidative stress and inflammation in Cafeteria diet-induced NAFLD rat model

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Background and objectives: Non-alcoholic fatty liver disease (NAFLD) becomes the most common disease in the world, and unhealthy eating habits maybe one of the key pathogenic factors. Cafeteria diet, providing human junk food with basal rat diet can successfully induce metabolic syndrome and NAFLD. Matcha, contains much more active compounds such as total phenolic, caffeine and catechin than green tea, however, the protective effects of matcha on NAFLD were still controversial. This study aims to investigate the protective effects of matcha on lipid metabolism and inflammation damage in Cafeteria diet-induced rat model.

Method: Forty-eight of 7-week-old male Wistar rats were divided into 6 groups (n=8), including control group (C) (normal diet, Labdiet 5001, Richmond, USA), C+0.2% Matcha group (C+0.2%), C+1% Matcha group (C+1%), Cafeteria group (Caf) (Cafeteria diet), Caf+0.2% Matcha group (Caf+0.2%) and Caf+1% Matcha group (Caf+1%). The Cafeteria diet contain cheese sandwich crackers, potato chips, milk puffs, sausages and blend with normal diet. Rats were sacrificed after 12 weeks.

Results: Body weight of Caf, Caf+0.2% and Caf+1% group were significantly increased when compared with C group. Blood sugar, serum insulin, HOMA-IR significantly increased at 12th week and improved in both matcha intervention groups. Cafeteria diet increased plasma leptin, adipose tissue weight and both matcha intervention groups showed reversed results in the above items. Plasma TG were increased by cafeteria diet and 1% matcha could improve the situation of it. The raise of liver TC and TG in Caf group were decreased after the intervention of 0.2% matcha. Hepatic tumor necrosis factor (TNF)-α, Interleukin (IL)-1β, IL-6 and IL-10 of Caf group were significantly increased than those of C group, 1L-1β were reduced in both matcha intervention groups when compared to Caf group while only 1% matcha improved the situation in TNFα and IL-6. Liver pathological section showed steatosis and inflammation results in Caf group and it reversed in both matcha intervention groups. NAFLD score was significantly increased in Caf group and matcha improved the steatosis score significantly.

Conclusion: These results suggested that combined treatment of matcha can alleviate insulin resistance, lipid accumulation and inflammation in Cafeteria diet-induced rat model.

Keyword: Cafeteria diet, Matcha, Lipid metabolism, Inflammation, Non-alcoholic fatty liver disease

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-62)
Effects of azuki bean polyphenols on glucose and lipid metabolism in mice fed a high-fat diet and the role of intestinal bacteria

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Background and objectives: Plant polyphenols (PPs), which have beneficial effect on obesity and diabetes, are partially absorbed in the intestinal tract, and most of them pass through the intestinal tract. We speculated that these unabsorbed PPs may regulate the metabolism by acting on intestinal bacteria. The purpose of this study was to investigate the role of intestinal bacteria in the modulatory effects of azuki bean PPs (APP) on metabolism.

Methods: Five-week-old male ICR mice were divided and fed *ad libitum* for 4 weeks: a control (C) diet and normal tap (N) water for CN and CNP groups, a high-fat (F) diet and N-water for FN and FNP groups, and the F-diet and antibiotic-containing (A) water for FA and FAP groups. The CNP, FNP, and FAP groups were also orally administered APP (40 mg/kgBW; daily) that was extracted from azuki beans. The intestinal flora, short-chain fatty acid (SCFA) contents of cecum, and blood chemistry were analyzed. The expression of insulin signaling factors in the liver was measured by western blotting.

Results: The antibiotic-treated groups (FA and FAP) showed cecum hypertrophy and liquefaction of its contents, decreased species diversity of the intestinal flora, and decreased SCFA contents. The FN group had significantly higher body and adipose tissue weights; these weights decreased in the FNP group, while the FAP group showed opposite trend. Plasma TG and HOMA-IR levels in the FNP group were significantly lower than those in the FN group, while there were no significant differences between FAP and FA groups. The CNP and FNP groups showed lower liver mTOR and Akt, and higher phosphorylated FoxO1 levels than respective control groups, while the FAP group showed opposite trend.

Conclusions: Administration of APP increased the diversity of the intestinal flora, inhibited fat accumulation caused by high-fat diet, lowered blood lipids, and improved insulin resistance via mTOR, Akt, and FoxO1. However, these effects were lost or reduced under the dysbiosis by antibiotics. Thus, this study indicate that intestinal bacteria may be involved, at least in part, in the physiological regulatory functions of APP.

Keyword: Plant polyphenols, Intestinal flora, Metabolism, High-fat diet, Antibiotics

PAB(T7-63)
Synergetic effect of dietary allitol and d-allulose on body fat accumulation in rats.

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Background and objectives: Allitol is rare sugar alcohol obtained by reducing d-allulose (d-psicose) and can be found in *Itea*, a deciduous shrub of the family Saxifragaceae, with d-allulose. Our previous study reported that the long-term feeding of rats with a dietary supplement of dried *Itea* powder suppresses body fat accumulation. The effect may be due to d-allulose and allitol contained in *Itea*. This finding suggested that allitol might have low available energy and an anti-obesity effect. However, information on the effects of long-term dietary allitol intake is limited. This study aimed to investigate the synergetic effect of allitol and d-allulose supplementation on body fat accumulation under restricted feeding in rats.

Methods: Thirty-two male Wistar rats (3 weeks old) were randomized into four groups of eight rats. The rats were fed with 10g of high sucrose diet (C), the C diet added 0.5g of d-allulose (P), 0.5g of allitol (A), or 0.5g of d-allulose and 0.5g of allitol (PA) for 12 weeks. After the experimental period, all rats were sacrificed by beheading. Blood was collected to obtain serum. The heart, liver, kidneys, spleen, cecum, and abdominal adipose tissues were quickly removed and stored at −80°C, and the carcass samples were stored at −20°C until analysis.

Results: Final body weight was significantly lower in the P and PA groups than that in the C group. The intra-abdominal adipose tissue weight and carcass fat mass were lower in the P and PA groups than that in the C group, whereas no significant difference has been observed between the C and A groups. A synergistic effect of allitol and d-allulose supplementation was found in the reduced intra-abdominal adipose tissue weight. The serum and cecal acetic acid were found to be significantly higher in the A and PA groups than those in the C and P groups.

Conclusion: In this study, the synergetic effect of allitol and d-allulose on intra-abdominal fat accumulation in rats has been clarified. Our results suggested that d-allulose inhibits lipogenesis from short-chain fatty acids produced by the cecal fermentation of allitol. Further research is needed to investigate its detailed mechanisms.

Keyword: allitol, d-allulose, body fat

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-64)
Effects of Neuropeptide GALP on Peripheral Glucose Metabolism via Hepatokinesis

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Background and objectives: GALP is a neuropeptide isolated and identified from the porcine hypothalamus. Previous studies have reported the anti-obesity effect of GALP. We found that intraventricular administration of GALP resulted in a gradual increase in respiratory quotient after 12 hours of administration. We thought that GALP also affects glucose metabolism, but the detailed mechanism has not been elucidated. In this study, we investigated the regulatory effects of GALP on glucose and lipid metabolism in the liver and skeletal muscle.

Methods: Eleven-week-old male C57BL / 6J mice were used as experimental animals, and saline or GALP was administered intraventricularly and dissected 16 hours later. Blood glucose levels and plasma lipid levels were measured, and mRNA expression levels of glucose metabolism-related genes in liver and skeletal muscle were measured.

Results: There was no significant difference in body weight between the two groups, but food intake decreased in the GALP group. There was no significant difference in blood glucose levels. G6Pase gene expression associated with hepatic gluconeogenesis was reduced in the GALP group. In addition, the gene expression of selenoprotein P (SeP), LECT2 and Fetuin-A, which are hepatkines and known to induce insulin resistance in the liver and skeletal muscle, was all decreased in the GALP group, and SeP and Fetuin-A were significantly decreased. On the other hand, GK, which is a glycolytic enzyme, gene expression tended to increase in the GALP group. There were no significant differences in gene expression associated with lipid metabolism.

Conclusions: In this study, glycolysis and suppressed gluconeogenesis in the liver enhanced by GALP. In addition, decreased expression of the SeP, LECT2 and Fetuin-A genes it is suggested that GALP regulates glucose metabolism via hepatkine.

Keyword: GALP , anti-obesity effect, glucose metabolism, Fetuin-A

PAB(T7-65)
Effects of dietary allitol on body fat accumulation in rats

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Background and objectives: Allitol is a rare sugar alcohol that can be obtained by reducing D-allulose (D-psicose) and can be found in Itea, a deciduous shrub of the family Saxifragaceae, with D-allulose. Our previous study has reported that the long-term feeding of rats with a dietary supplement of dried Itea powder suppresses body fat accumulation. The effect may be due to D-allulose and allitol contained in Itea. This finding suggested that allitol might have low available energy and an anti-obesity effect. However, information on the effects of long-term dietary allitol intake is limited. This study aimed to investigate the effect of allitol supplementation, as a sugar substitute, on body fat accumulation in rats compared with that of sucrose, rare sugar D-allulose, or erythritol.

Methods: Thirty-two male Wistar rats (3 weeks old) were fed experimental diets including 5% sucrose, allitol, erythritol, or D-allulose for 8 weeks ad libitum. Bodyweight and food intake were recorded daily. After the experimental period, all rats were sacrificed by beheading. Blood was collected to obtain serum. The heart, liver, kidneys, spleen, and abdominal adipose tissues were quickly removed and stored at −80°C until analysis. Carcass samples were obtained by removing the head, the remains of the intra-abdominal and intra-thorax tissues. They were stored at −20°C until analysis of carcass fat.

Results: No significant difference has been observed in weight gain, food intake, and food efficiency among the groups. The total body fat mass and percentage, and intra-abdominal adipose tissue weights were found to be significantly lower in rats fed with the allitol diet than in those fed with the sucrose diet. These body fat indicators tended to be lower in rats fed with the erythritol and D-allulose diets than in those fed with the sucrose diet, but no significant difference has been observed.

Conclusion: In this study, the anti-obesity effect of allitol in rats has been clarified. Furthermore, the anti-obesity effect of allitol may be equal to or greater than that of D-allulose. Further research is needed to investigate the allitol's anti-obesity effect and metabolic pathway.

Keyword: allitol, D-allulose, body fat

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-66)
Effect of dynamic high-pressure treated chicken meat on skeletal muscle of sarcopenia model mice

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Background and objectives: The water pressure in running water is called dynamic high-pressure (DHP), and it is characterized by the physical forces of shear, impact, and cavitation that act with the pressure. DHP treatment of protein is expected to modify the structure of protein and improve absorption. Exercise and high-quality protein intake are necessary to prevent sarcopenia, which has become a nutritional problem in an aging society in recent years. However, most of the protein supplements on the market are powders obtained by enzymatically treating milk and soybeans. In this study, chickens were DHP-treated with a high-pressure homogenizer and tested in vitro for improved absorption of denatured protein. Furthermore, the effects of Ezm+DHP intake the increase in skeletal muscle mass was investigated in sarcopenia model animals.

Methods: Chicken breast strips were treated with DHP (150MPa, 15passes: DHP), enzymatic (protease, 30min: Ezm), and combination of them (Ezm+DHP). Then they were freeze-dried and pulverized. Protein denaturation was evaluated by the protein solubility test and quantification of amino groups by OPA method. Improvement digestibility of these samples were evaluated by artificial digestive test. SAMP8, which develops sarcopenia due to accelerated aging, were given Control diet containing CTL(n=10) or a test diet containing Ezm+DHP(n=10), and treadmill training was performed for 5 months.

Results: The results of the protein solubility test, DHP and Ezm+DHP decreased hydrogen bonds and increased hydrophobic interactions. The quantitative of amino groups increased significantly in the order of DHP, Ezm, and Ezm+DHP relative to CTL. This result suggests that the lowest molecular weight is achieved in the combined treatment of Ezm+DHP, rather than in the treatment of Ezm or DHP alone. Ezm+DHP diet group was shown to have significantly increased the extensor digitorum longus muscle (EDL) compared to that of the CTL diet group.

Conclusions: These results indicate that intake of meat reduced in molecular weignht by Ezm+DHP treatment improved protein absorption, and amino acid or prptides retained in the body were used for skeletal muscle synthesis through endurance exercise. Ezm+DHP-treated meat could become a new protein material in the future.

Keyword: Dynamic high-pressure, Skeletal muscle, Peptide, SAMP8, Sarcopenia

PAB(T7-67)
Influence of a long-term diet including Tsuyama-grown apios on gastrointestinal function

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Background and objectives: Apios americana Medikus is a member of the legume family Apios fortune, containing isoflavones and DDMP saponins, and also showing a weak alpha-glucosidase inhibitory effect as its functional activities. The activities of these functional components have been reported to indicate biological defense, anti-cancer, anti-inflammatory and anti-hyperglycemic effects. However, detailed mechanistic understanding and evidence for efficacy and safety of Apios components are limited. In this study, wild mice were fed Apios powder-containing diets in order to evaluate the effects and safety of Apios.

Methods/Results: Apios and potato (as a control) were freeze-dried, powdered and admixed with a standard powdered feed at a final concentration of 20% (w/w). Wild mice (C57BL/6, 8 weeks old) were fed 20% Apios or potato powder-containing diets ad libitum for 62 weeks. Compared to the potato group, the Apios group tended to increase food intake, while its body weight significantly decreased. In the Apios group, AST and ALT values decreased, and HDL value significantly increased compared to the potato group. The Apios diet reduced sizes of lipid droplets in liver, suggesting Apios decreases fat accumulation in the livers of 70-week-old aged mice. The number of goblet cells in intestinal villus and the thickness of the circular and longitudinal muscle layers in the small intestine increased in the Apios group, suggesting increases in mucin secretion and peristaltic movements in the small intestine of the Apios group.

Conclusions: Apios-containing diet might be associated with anti-aging effects.

Keyword: Apios, Functional Foods

PAB(T7-68)
Protease treated royal jelly enhance muscle regeneration though the regulation of muscle stem cell proliferation

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Background and objectives: Royal jelly (RJ) is involved in longevity and fertility in the queen honeybee. RJ is generally

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

considered beneficial to skeletal muscle health. We recently reported that protease-treated RJ (pRJ), which we had developed to reduce anaphylactic reactions, prevents the skeletal muscle atrophy following denervation. However, in contrast to atrophy, the exact effect and mechanism of pRJ on muscle regeneration remains unknown.

Methods: Lyophilized protease-treated RJ was prepared by Yamada Bee Company. Experimental diets were prepared by mixing pRJ with commercially available powder diet at a concentration of 1%. Four-week-old female C57BL/6 mice were fed control diet or pRJ diet for 3 weeks pre and for 7 days post-operation. Muscle regeneration was induced by injecting 50 µl of 10 µM cardiotoxin into tibial anterior muscle. Single fibers of the muscle were extracted from the extensor digitorum longus muscles and treated with or without 0.5 mg/ml pRJ solution. C2C12 cells were treated with or without 1.0 mg/ml pRJ solution for 2 days after which total RNA was isolated. Gene expression levels were determined by RNA-seq analysis. Target genes of microRNAs were predicted using TargetScan bioinformatics software.

Results and Discussion: The fiber size of regeneration muscle was increased in pRJ fed group. pRJ treatment stimulated the increment of the number of satellite cells, skeletal muscle stem cells. Treatment of C2C12 cells with pRJ downregulated 155 genes and upregulated 124 genes. Two microRNAs, miR-29a and miR3058 were amongst the 155 significantly downregulated genes. 51 of the 155 downregulated genes (33%) were predicted to be targets of either miR-29a or miR3058. These data suggest that pRJ induces skeletal muscle regeneration though the regulation of stem cell proliferation. It is also indicated that miR-29a and miR3058 play an important role in the regulation of gene expression downstream of pRJ treatment.

Conclusions: pRJ induces regeneration of skeletal muscle via activation of satellite cell proliferation. Therefore, pRJ is a natural product which contributes to keep the health of skeletal muscle.

Keyword: Royal jelly, Muscle stem cell, Regeneration

PAB(T7-69)
Effects of milk basic protein supplementation on bone density and bone metabolism markers in female college long-distance runners: A double-blind randomized controlled trial

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Objective: It has been reported that long-distance runners have a high incidence of stress fractures. Milk basic protein has been shown to help build healthy bones in people of all ages. However, little is known about how milk basic protein function in athletes. Therefore, we clarified the effect of milk basic protein ingestion on bone mineral density and bone metabolism markers and decided to use it to reduce the incidence of stress fractures in athletes and improve bone strength.

Methods: This was a double-blind, randomized controlled trial. The ingestion group was instructed to consume a soft drink containing 40 mg of milk basic protein, and the non-ingestion group was instructed to consume a 50-mL bottle of placebo soft drink daily for 6 months. Thirteen of the 14 participants, excluding one who declined to participate in the study, were stratified and randomized based on their baseline height, weight, and lumbar bone mineral density measurements; the ingestion group included six women, and the non-ingestion group included seven women. The survey included physical measurements, bone mass/density measurements, blood/urine biochemical tests, food ingestion frequency surveys, and menstrual and mileage surveys. The survey period was from May to December 2019.

Results: There were no significant differences in the changes in bone formation, bone resorption, or bone quality markers between the two groups. However, when the bone formation rate (= bone formation marker/bone resorption marker) was calculated, a higher bone formation rate was observed in the ingestion group, although the difference was not significant. Regarding changes in bone mineral density, the radial cancellous bone mineral density tended to be higher in the ingestion group than in the non-ingestion group, and the lumbar spine bone mineral density was higher in the ingestion group.

Conclusion: An increase in radial cancellous bone mineral density and lumbar spine bone mineral density were observed after ingestion of milk basic protein for 6 months. This indicates that the bone mineral density of athletes may increase.

Keyword: milk basic protein, BMD, bone metabolism markers, long-distance runners

PAB(T7-70)
Effect of Kiwifruit Intake on Antioxidant Activity and Mood among College Male Middle- and Long-Distance Runners

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Background and Objectives: Long-distance runners exercise for many hours on a daily basis, which may increase oxidative stress and expose them to psychological stress. Kiwifruit is rich in vitamins C and E and can be expected to enhance antioxidant activity and suppress the increase in oxidative stress. Furthermore, Kiwifruit is thought to have the effect of reducing psychological stress. The objective of the study is to clarify the effects of kiwifruit intake on antioxidant activity and mood of college male middle-and long-distance runners.

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DOI: 10.1159/000530786

Methods: Study (1): Thirty middle-and long-distance runners belonging to the Track and Field Club of A college were investigated from May to July 2017. They were divided into two groups: intake group (15 subjects) who consumed kiwifruit for a month, and non-intake group (control: 15 subjects) who did not consume kiwifruit. The changes in d-ROMs (oxidative stress), BAP (antioxidant activity), and BAP/d-ROMs ratio (potential antioxidant capacity) were compared between the two groups. Study (2): Thirty-six middle-and long-distance runners belonging to the Track and Field Club of A college, similar to Study (1), were investigated from August to October 2020. They were divided into two groups: intake group (16 subjects) who consumed kiwifruit for two months and non-intake group (control: 20 subjects) who did not consume kiwifruit. The changes in each scale (AH: anger, CB: confusion, DD: depression, FI: fatigue, TA: tension, VA: vigor, and TMD: total mood disturbance) were compared between the two groups.

Results: Study (1): In the intake group, d-ROMs significantly decreased while the BAP/d-ROMs ratio significantly increased after the intervention compared to pre-intervention. However, in the control group, no significant difference was observed in all items. Study (2): In the intake group, AH significantly increased after the intervention, with no increase observed in other scales compared to pre-intervention. However, in the control group, AH, CB, DD, and several other negative mood scales significantly increased.

Conclusions: Both studies suggest that intake of kiwifruit, with its high antioxidant activity, may improve potential antioxidant ability by decreasing d-ROMs and maintaining BAP. Furthermore, it was suggested that intake of kiwifruit may possibly affect psychological factors.

Conflict of Interest Disclosure: The authors (Kazuhiro Uenishi) have financial conflicts of interest disclose concerning the study from Zespri International (Japan) K.K. We receive kiwifruit offerings from the company.

Keyword: Runners, Kiwifruit, Antioxidant activity, d-ROMs, BAP

PAB(T7-71)
Cirsium setidens water extracts containing linarin inhibit estrogen deficiency-induced osteoporosis in mice

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Background and objectives: Osteoporosis typically manifest in postmenopausal women is an osteolytic disease characterized by bone loss that further increases the susceptibility to bone fractures and frailty. The use of complementary therapies to alleviate postmenopausal osteoporosis is fairly wide-spread among women. Edible Cirsium setidens contains various polyphenols of linarin, pectolinarin, and apigenin with antioxidant and hepatoprotective effects. This study aimed to determine whether linarin present in Cirsium setidens water extracts (CSE) and its aglycone acacetin inhibited ovariectomy (OVX)-induced bone loss.

Methods: This study employed OVX C57BL/6 female mice as a model for postmenopausal osteoporosis. CSE, acacetin or linarin was orally administrated to the OVX mice at a dose of 20 mg/kg for 8 weeks.

Results: Surgical estrogen loss of mice for 8 weeks reduced bone mineral density (BMD) of mouse femurs and serum 17β-estradiol level, and enhanced serum receptor activator of NF-κB ligand (RANKL)/osteoprotegerin ratio with uterine atrophy. CSE and linarin ameliorated uterine atrophy with an increase in serum 17β-estradiol level and enhanced femoral BMD in OVX mice. Oral administration of CSE and linarin attenuated TRAP activity and expression of αβ integrins and carbonic anhydrase II elevated in femoral bone tissues of OVX mice. In addition, CSE and linarin curtailed bone levels of cathepsin K and matrix metalloproteinase-9 responsible for osteoclastic bone resorption. These findings showed that CSE and linarin inhibited lacunar acidification and bone matrix degradation in the osteoclast-bone interface. Further, supplementing CSE, acacetin or linarin to OVX mice elevated formation of collagen fibers in OVX trabecular bones, evidenced by Masson's trichrome staining. Accordingly, the presence of CSE and linarin inhibited bone resorption accelerated by surgical estrogen deficiency along with increased bone matrix formation.

Conclusions: CSE rich in linarin effective in retarding osteoclast function and active bone resorption and promoting bone formation and matrix mineralization may be a natural compound targeting against postmenopausal osteoporosis and pathological osteo-resorptive disorders.

Keyword: Acacetin, Cirsium setidens, linarin, ovariectomy, postmenopausal osteoporosis

Funding Sources: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2021R1A6A1A03044501).

PAB(T7-72)
Dietary ferulic acid suppresses body fat accumulation via induction of beige adipocyte formation and cyclodextrin inclusion ferulic acid improves bioavailability in mice.

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Background and objective: It has been reported that dietary ferulic acid (FA) significantly suppressed body fat accumulation, despite its poorly soluble in water and low oral bioavailability [1]. However, molecular mechanism of this effect remains unclear. We hypothesized that anti-obesity by dietary FA is due to

induction of beige adipocyte formation. In addition, highly water soluble and bioavailable FA formulation would be able to obtain FA-mediated various biological function even at low doses. Several reports indicated that cyclodextrin (CD) inclusion complex can enhance its oral bioavailability [2]. Therefore, CD inclusion FA (CD-FA) can be expected to induce beige adipocyte formation even at low doses. According to these backgrounds, the aim of this study is to demonstrate induction of beige adipocyte formation by dietary FA, evaluation of bioavailability of CD-FA, and dietary CD-FA-mediated beige adipocyte formation at low doses.

Methods: 1) Five-week-old male C57BL/6J mice were assigned to four different groups: control diet group, control diet supplemented with 0.2, 0.5, or 1.0 % FA groups (0.2FA, 0.5FA and 1.0FA) for 4 weeks. After 4 weeks, blood and adipose tissue samples were collected. 2) Mice received single oral doses of native FA or CD-FA by intragastric intubation. Blood and inguinal white adipose tissue (iWAT) samples were collected at 15, 30, 60, 120 and 240 min after loading. FA concentration in plasma and iWAT were determined.

Results: Overall weight gain as well as WAT weight significantly decreased in the 1.0FA group relative to the control. Dietary FA (0.5 and 1.0FA groups) significantly induced beige adipocyte formation in iWAT in mice. Both total (free and conjugated form) and free form of FA in plasma concentration were significantly elevated after CD-FA compared with these of native FA. **Conclusions:** Dietary FA significantly induces beige adipocyte formation in iWAT and contributes suppression of body fat accumulation. CD-FA significantly improves low bioavailability of native FA. We are continuing to examine whether CD-FA induces beige adipocyte formation even at low doses.

Keyword: ferulic acid, beige adipocyte, cyclodextrin

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PAB(T7-73)
Is lactate an exercise-replacement food-derived factor? Investigation from stimulation of TGFβ2 secretion and induction of beige adipocyte formation

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Background and objective: Lactate has long been considered a waste product of anaerobic metabolism. However, recent studies indicate that lactate is an important signaling molecule that regulates various metabolic processes in the body. Furthermore, the exercise-induced production of lactate is reported to stimulate the secretion of transforming growth factor-beta 2 (TGFβ2) from white adipose tissue (WAT), leading to the suppression of body fat accumulation [1]. In addition, we recently demonstrated that the intake of an amino acid mixture combined with exercise synergistically induced beige adipocyte formation in inguinal WAT (iWAT), which was associated with a significant elevation of plasma lactate levels [2]. According to these findings, we hypothesized that the oral intake of lactate would provide various exercise-related benefits in the absence of exercise. Therefore, the aim of this study was to examine whether lactate intake stimulates TGFβ2 secretion and beige adipocyte formation.

Methods: Five-week-old male C57BL/6J mice were allowed to ingest sterilized water or 100 mM sodium L-lactate solution ad libitum. After 4 weeks, plasma and WAT were collected. C3H10T1/2 cells were differentiated into beige adipocytes and then treated with lactate and/or *N*-acetylcycteine (NAC). After treatment, reactive oxygen species (ROS) production and uncoupling protein 1 (UCP1) mRNA levels were determined.

Results: Lactate intake did not significantly increase plasma TGFβ2 levels, despite the increase in plasma lactate levels. However, lactate significantly induced beige adipocyte formation in iWAT. Lactate significantly induced the expression of the lactate transporter MCT1 and lactate dehydrogenase B (LDHB). These data suggest that lactate incorporated via MCT1 is metabolized into pyruvate by LDHB, which would increase the $NADH:H^+/NAD^+$ ratio and ROS production. Lactate treatment significantly induced ROS production and UCP1 expression in differentiated C3H10T1/2 cells, which were significantly suppressed by treatment with NAC.

Conclusions: Lactate intake induces beige adipocyte formation. ROS function as a second messenger of lactate and are involved in the induction of beige adipocyte formation. Lactate may be used as an exercise-replacement food-derived factor.

Keyword: lactate, TGFβ2, beige adipocyte

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PAB(T7-74)
Combination of exercise and intake of β-conglycinin synergistically induces beige adipocyte formation in mice

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Background and objectives: Soy protein contains about 20 % of β-conglycinin (β-Con). It has been reported that a significant suppression of body fat accumulation was observed when the protein source was only β-Con [1]. Several published reports have shown that exercise (EX) induces the development of beige adipocytes in white adipose tissue (WAT) [2]. Based on these findings, it is likely that a combination of food-derived factors and EX may effectively induce beige adipocyte formation in WAT, thus contributing to body weight control or providing other EX-mediated health benefits. In addition, it may be difficult to ingest only soy protein as the entire protein source for nutrition for

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

many people. Accordingly, we hypothesized that the combination of EX and intake of soy protein synergistically induces beige adipocyte formation. Therefore, the aim of this study is to examine whether intake of protein partially replaced by β-Con combined with EX significantly induces beige adipocyte formation, as well as to clarify possible mechanisms by which β-Con combined with EX induce beige adipocyte formation.

Methods: Five-week-old male C57BL/6J mice were assigned to one of four groups: sedentary control (AIN-93G based diet), sedentary control + 50β-Con diet (Half of the protein sources in the diet were β-Con), EX (AIN-93G based diet), and EX + 50β-Con diet (Half of the protein sources in the diet were β-Con). After 4 weeks, adipose tissue and liver were collected.

Results: 50β-Con diet combined with EX for 4 weeks synergistically induced beige adipocyte formation compared with 50β-Con or EX alone in mice. Plasma FGF21 concentration and the mRNA level was significantly increased in EX + 50β-Con group. Furthermore, activating transcription factor 4 (ATF4), which is one of the triggers of upregulation of FGF21 expression was also significantly increased in EX + 50β-Con group.

Conclusions: 50β-Con combined with EX synergistically induced beige adipocyte formation in association with ATF4-FGF21 signaling in the liver. Our findings suggest that it is not necessary to ingest all protein source from only soy protein in order to expect induction of beige adipocyte formation.

Keyword: β-conglycinin, exercise, UCP1, FGF21

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[2] *Diabetes* 64: 2002–2014 (2015).

PAB(T7-75)
Anti-aging effects of constituents in *Moringa oleifera* Leaves

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Background and objects: The people have an interest for health, and cosmetics market and the health food market accomplish sudden growth. Also, the use of the natural system material in behalf of the synthetic pathway material by the naturalism point is demanded. The search of these new materials becomes the important research theme. Therefore we search for an ingredient derived from nature for the purpose of the anti-aging. In this study, we examined the anti-aging effects (AGEs inhibitory activity) in the leaves of *Moringa oleifera*.

Methods: As a means to evaluate anti-glycation, we conducted the AGE inhibition test. Remarkable inhibitory active substance in the leaves of Moringa oleifera was separated by gel filtration and silica gel column chromatography.

Results: Six compounds were isolated from the leaves of *Moringa oleifera*, and their structures were established on basis of MS and NMR spectroscopy. They were 1-(4'hydroxyl-3'-methoxyphenyl)-2-{2-menthoxy-4-[1-propen-3-*O*-glucopyranosyl]-phenoxy}-propan-1,3-diol 1, 4'-Acetyl-niazirin 2, niazirin 3, kaempferol 3-*O*-glucopyranoside 4, quercetin 3-*O*-glucopyranoside [5] and 4-rhamnopyranosiloxy phenyl carbamate [6] . As a result, compounds 1 -5 showed high AGEs inhibitory activity.

Conclusions: As for compounds and extracts, it might be used in general as supplement and food additives to take every day.

Keyword: Moringa oleifera, AGE inhibitory activity, anti-glycation, food additives, supplement

PAB(T7-76)
A Change Point Regression Model for Treatment Effects Estimation of Functional Foods in a Pre-Post Design

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Background and Objective: In an intervention study for functional foods, the study population is often a mixed group of healthy individuals and/or those who are not so healthy but are not definitely disease. This is one of the major differences between using pharmaceuticals and functional foods. However, statistical analysis of human trials involving healthy and disease-bordering individuals requires stratified analysis, which is problematic in terms of increased sample size and higher study costs. For such heterogeneous populations, we propose an alternative approach for evaluating the efficacy of dietary supplements and functional foods based on a change point regression model (CPRM).

Methods: CPRM: Consider the following CPRM for between-group comparisons of RCT,

$$y_i=\alpha+b_1x_i+b_2I(x_i x_{cp})(x_i<x_{cp})g_i+e_i \ (\ i = 1,2,3,\ldots,n\ )$$

where n is the number of participants, y_i is the observation at the study's end of participant i or the change from baseline after treatment, x_i is the observation at baseline of participant i, x_{cp} is a constant, g_i is the group indicator (control = 0; treatment = 1), and $I(\cdot)$ is an indicator function defined as $I(x_i<x_{cp}) = 1$, if $x_i \geqq x_{cp}$ and as 0 otherwise. The proposed method was applied to skeletal muscle ratio study data, and the merit of the proposed method was demonstrated by comparing it with the conventional method.

Results: Applied to the skeletal muscle ratio study data, the results showed that the CPRM was indicated more fitting to data and power of statistical analysis was stronger than the conventional method. And, the CPRM also provides useful information, change-point as efficacy appearance point.

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DOI: 10.1159/000530786

Conclusion: We have proposed a new approach for the efficacy evaluation of dietary supplements or functional foods based on a CPRM. By using AIC-based profile likelihood methods, inferences can easily be made with standard statistical software. The proposed method was applied to the s skeletal muscle ratio study data, and the merit of the method was demonstrated by comparing it with the conventional method.

Keyword: Change Point Regression Model, Functional foods, Randomized Controlled Trial, AIC

PAB(T7-77)
Impact of fish oils and/or probiotics on serum CathepsinD in pregnancy

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Background and objectives : Serum CathepsinD (CatD) has been proposed as a new marker for liver inflammation. Overweight and obese pregnant women as well as those with gestational diabetes mellitus (GDM) have a higher risk for developing metabolic inflammation and nonalcoholic fatty liver disease. The objective was to investigate whether supplementation with probiotics and fish oil separately or in combination, would exert any effect on CatD concentrations during pregnancy, and whether the effect is GDM dependent.

Methods: Overweight/obese pregnant women (n=438) were randomized into fish oil+placebo, probiotics+placebo, fish oil+probiotics or placebo+placebo groups. Fish oil contained 1.9 g docosahexaenoic acid and 0.22 g eicosapentaenoic acid and probiotics were *Lacticaseibacillus rhamnosus* HN001 (formerly *Lactobacillus rhamnosus* HN001) and *Bifidobacterium animalis ssp. lactis* 420, 10^0 colony-forming units each. Serum CatD levels were analysed by ELISA at early and late pregnancy. GDM was diagnosed by OGTT.

Results: CatD concentrations did not differ among the intervention groups or by GDM status. The CatD concentrations decreased from early to late pregnancy in the fish oil group (-37.8±121.5 ng/ml; p=0.004) and in the probiotic group (-41.5±105.6 ng/ml; p<0.001), but not in the combined intervention group (-13.4±161.9 ng/ml; P=0.434) or in the placebo group (-1.4±125.9 ng/ml; p=0.901).

Conclusion: The serum CatD concentration of pregnant women was not modified by this dietary intervention. A decrease in CatD concentrations due to the consumption of either probiotics or fish oil supplements, but not the combination, was seen, an observation that deserves further investigation.

Keyword: CathepsinD, liver inflammation, obesity, fish oil, probiotics

Conflict of Interest Disclosure: None

PAB(T7-78)
Antihyperglycemic effect of cardamom through promotion of glucose uptake in skeletal muscle cells

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Objectives: Diabetes is a metabolic disease with high incidence in the world. Many studies have shown that spices have multiple biological regulatory functions, including preventing hyperglycemia. In our previous report, we prepared the hot-water washed ethanol extract from 24 kinds of spices and measured the glucose uptake activity in L6 myoblasts and found that nutmeg, turmeric, cardamom and pepper showed significant increase in the glucose uptake activity. In this study, we focused on cardamom and tried to isolate and identify the effective compound that can promote the glucose uptake activity in L6 myotubes. We also carried out an oral glucose tolerance test in mice to verify the anti-hyperglycemic effect of the extract.

Methods: Isolation of the effective fraction was performed by solvent partition and HPLC. Identification of the effective compound and its chemical structure was investigated by instrumental analyses. Cardamom extract, its fractions and isolated compound were subjected to measurement of the glucose uptake activity by enzymatic 2DG uptake assay.

Results: When the ethanol extract of cardamom was step-wisely separated by solvent partition using hexane, ethyl acetate, chloroform, butanol, and water, the ethyl acetate and chloroform fractions significantly promoted glucose uptake. The ethyl acetate fraction was orally given to mice and performed oral glucose tolerance test to confirm its effect on preventing hyperglycemia. Then, the ethyl acetate fraction was applied to HPLC and separated four sub-fractions. It was found that Fr. 3 promoted glucose uptake. This fraction was further separated ten fractions by HPLC. Of these, it was found that Fr. A-g, Fr. A-h and Fr. A-i promoted glucose uptake in L6 myotube cells. From UV-scanning data, these sub-fractions may contain terpenoids and flavonoids. Further isolation and identification of the effective compounds are in progress.

Conclusion: The ethyl acetate fraction from the ethanol extract of cardamom prevented postprandial hyperglycemia. This fraction may contain several effective compounds including terpenoids and flavonoids and these effective compounds may contribute to prevention of hyperglycemia.

Keyword: Cardamom, Hyperglycemia, Diabetes, Glucose uptake

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-79)
Bioavailability of maltobionic acid, newly developed nondigestible oligosaccharide, in humans

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Background and objectives: Maltobionic acid (MA), formed by a gluconic acid and glucose linked by α-1,4 bond, may have the property of a nondigestible oligosaccharide. The objective of this study is to elucidate the bioavailability of MA in humans by observing digestion and absorption of MA, excretion rate to urine, and the fermentation of MA by gut microbiota.

Methods: Experiment1: Observation of digestibility of MA; A within-subject repeated measures design was used for experiments with 10 healthy females. After participants ingested the equivalent of 10 g of MA dissolved in 200 ml of safely distilled water, blood was collected by puncturing a fingertip: before ingestion and 30, 60, 90, 120, 150, and 180 min after ingestion of the test material. Urine was collected by asking participants to pass urine before ingestion and at 4 and 8 h after ingestion. Plasma glucose concentration was measured using the glucose oxidase method. Insulin concentration was measured using the ELISA method. MA in urine was measured using HPLC. Experiment 2: Observation of fermentability of MA; A within-subject repeated measures design was used for experiments with 11 healthy females. For the test, participants ingested the equivalent of 5 g of MA or 5 g of fructooligosaccharide dissolved in 150 ml of safely distilled water. After ingestion of the test material, end-expiratory gas was collected at 1-h intervals for 8 h and at 2-h intervals until 14 h to measure breath hydrogen. The breath hydrogen concentration was measured using gas chromatography, and the area under the curves (AUCs) was calculated 0–14 h after ingestion.

Results: Ingestion of 10 g of MA did not elevate postprandial plasma glucose and insulin levels. The urinary excretion of MA was very small amounts. These results demonstrate that MA is negligibly digested and absorbed in the small intestine. Compared with the AUCs of breath hydrogen excretion for 14 h related to the ingested fructooligosaccharide, MA was 23.1%.

Conclusions: MA is highly resistant to digestion and fermentation. It expresses the characteristics of a nondigestible oligosaccharide, including being low energy.

Keyword: maltobionic acid, bioavailability, digestibility, fermentation, non-digestible oligosaccharide

Conflict of Interest Disclosure: Fructooligosaccharide was provided by Meiji. This research and providing maltobionic acid were supported by San-ei Sucrochemical Co., Ltd.

PAB(T7-80)
Intact and glucuronidated flavonoid metabolites can promote NO production in HUVECs

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Background and objectives: A target compound, 3-(4-hydroxy-3-methoxyphenyl) propionic acid (HMPA), is a metabolite that is produced from flavonoids in the gut by microbiota. In this study, to clarify the physiological roles of HMPA and its possible metabolic forms in blood, we investigated their ability to produce nitric oxide (NO), a vasorelaxant trigger for preventive hypertension, in human umbilical vein endothelial cells (HUVECs).

Methods: HUVECs were cultured in EBM-2 medium using a bullet-kit containing growth factors and incubated at 37°C in a 5 % CO_2 incubator. Cells at the fourth passage were seeded in 24-well plates at a density of 5×10^4 cells. The NO assay was performed in the presence or absence of inhibitors regarding incorporation routes such as monocarboxylic acid transporter (MCTs) and organic anion transporting polypeptides (OATPs), by fluorometric NO assay kit (E_x/E_m: 360 nm/460 nm).

Results: Among the three targeted HMPAs, i.e., HMPA, glucuronidated HMPA (HMPA-GlcA), and sulfated HMPA (HMPA-S), HMPA and HMPA-GlcA showed a significant increase of NO level in HUVECs production at 1 μM concentration for 24 h-incubation: HMPA, 210 ± 18%; HMPA-GlcA, 194 ± 13% *vs. control,* $p < 0.05$). In contrast, HMPA-S conjugate form had no power to increase NO production, indicating that not only HMPA skeleton, but also glucuronic acid moiety may stimulate NO signaling cascades. The evidence that MCT and OATP inhibitors significantly ameliorated the NO promotion by HMPA and HMPA-GlcA strongly suggested that both HMPA and HMPA-GlcA was incorporated into cells to exert NO production.

Conclusions: The present results demonstrates that a flavonoid metabolite HMPA and its metabolic conjugate HMPA-GlcA are a novel NO promotor by incorporating into HUVECs.

Keywords: HMPA, conjugates, nitric oxide, HUVECs, anti-hypertension

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-81)
Metabolic behavior of soybean protein glycinin in rat bloodstream by a coumarin-tagged MALDI-MS analysis

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Background and objectives: Metabolic behavior of dietary proteins in the body system remains unascertained. In this study, soybean glycinin was orally administered to Sprague-Dawley (SD) rats to clarify the metabolic fragments in the bloodstream. To achieve the overall identification, we tried to establish a highly sensitive and selective detection method by a matrix-assisted laser desorption/ionization-mass spectrometry (MALDI-MS), in combination with several amine derivatization techniques.

Methods: For the optimization of MALDI-MS measurement, synthetic oligopeptides containing sarcosine (*N*-methyl-Gly, S) [GSS, GSSS, and GSSSS ($[M + H]^+$ = 218.1, 289.1, and 360.2 *m/z*, respectively)] were used in this study. Identification of metabolic fragments in glycinin-administered (100 mg/kg) SD rat plasma was conducted with the proposed MALDI-MS in a positive ionization mode.

Results: Synthetic oligopeptides were subjected to amine derivatizations, using either 3-aminopyridyl-*N*-hydroxysuccinimidyl carbamate (APDS), 2,4,6-trinitrobenzenesulfonic acid (TNBS), or 7-*O*-methyl-3-coumarin (Cou). Among the amine derivatizations, Cou-derivatization (30 mmol/L, 30 min, 25 ℃, pH 8.5) caused successful MALDI-MS detection of peptides by Cou-tagged mass increment of +202.0 *m/z*, while no detections of APDS- and TNBS-tagged oligopeptides were observed. Sensitive detection of oligopeptides (> 5 pmol/spot) was confirmed when DHB (10 mg/mL) was used as a matrix agent. With the aid of the proposed Cou-tagged MALDI-MS method, 15 characteristic MS signals corresponding to di- to tetrapeptides in glycinin sequence were observed in glycinin-administered plasma collected at 0.5 to 8 h (e.g., AI, LIV, YSPY).

Conclusions: By applying the proposed highly selective and sensitive Cou-tagged MALDI-MS method, it was demonstrated that the oral intake of soybean glycinin resulted in a production of a variety of oligopeptides in rat bloodstream.

Keyword: Glycinin, metabolite, peptide, MALDI-MS, coumarin

PAB(T7-82)
Carotenoid transporter CD36 expression depends on HIF-1α under normal physiological conditions in soleus muscles of mice

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Background and objectives: Skeletal muscles play critical roles in physical activities, such as postural maintenance and locomotion, as well as regulating energy metabolism throughout the body. Dietary β-carotene induces muscular hypertrophy and prevents atrophy in red slow-twitch soleus muscles, but not in white fast-twitch extensor digitorum longus (EDL) and gastrocnemius muscles.[1,2] However, it remains unclear why these beneficial effects of β-carotene are elicited in the soleus muscles. In this study, we focused on the expression levels of carotenoid transporters in red and white muscles to elucidate the mechanism underlying the beneficial effects of β-carotene on soleus muscles.

Methods: C57BL/6J mice were orally administered micellar β-carotene, and small interfering RNA (siRNA) targeting *Cd 36* was transfected into their hind limb muscles. To evaluate hypoxic levels in the muscles, the hypoxia marker pimonidazole was injected into the tail veins of mice. CD36 expression in murine C2C12 myotubes was evaluated.

Results: *Cd 36* mRNA levels were higher in the red muscle than in the white muscle of mice. The *Scarb1* and *Npc1l1* mRNA levels were not significantly different between the soleus and EDL muscles. siRNA-mediated knockdown of CD36 decreased β-carotene uptake in C2C12 myotubes. In soleus muscles, CD36 knockdown inhibited the β-carotene-induced increase in soleus muscle mass. Intravenous injection of pimonidazole produced more pimonidazole-bound proteins in soleus muscles than in EDL muscles. Hypoxia-inducible factor-1α (HIF-1α) protein levels were higher in soleus muscles than in EDL muscles. In C2C12 myotubes, hypoxia increased the CD36 expression at both the mRNA and protein levels. Consequently, HIF-1α knockdown reduced *Cd36* mRNA levels in C2C12 myotubes as well as soleus muscles.

Conclusions: CD36 is predominantly involved in the β-carotene-induced increase in soleus muscle mass in mice. CD36 expression depends on HIF-1α in the soleus muscles of mice even under normal physiological conditions.

Keyword: Carotenoid transporter, CD36, β-carotene, hypoxia-inducible factor-1α, skeletal muscle

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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-83)
Degranulation of RBL-2H3 cells is synergistically inhibited by the combination of nobiletin and lactoferrin

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Background and objectives: We have previously shown that a methanol extract of Shikuwasha (*Citrus depressa* Hayata) leaves and peel had a strong inhibitory effect on the allergic response. However, the suppressive effect of Shikuwasha may be modulated by food consumed at the same time. Thus, knowledge of the effects of a combination of Shikuwasha and other food ingredients is needed. The aim of this study was to elucidate the anti-allergic effect of polymethoxyflavonoids (PMFs), which are abundant in Shikuwasha leaves and peel, in combination with milk proteins, and the inhibitory mechanism.

Methods: The rat basophilic leukemia cell line RBL-2H3 was exposed to the PMFs nobiletin (NOB), tangeretin (TNG), and sinensetin (SNT) and the milk proteins lactoferrin (LF) and β-lactoglobulin (β-LG), and β-hexosaminidase was used as an indicator of degranulation inhibition. Then, we examined the effect of co-stimulation of the two factors that showed the strongest degranulation inhibition effect in the PMF and milk protein groups, and investigated the mechanism of action by measuring the intracellular Ca^{2+} concentration, and western blot analysis.

Results: The strongest degranulation inhibitors were NOB in the PMF group and LF in the milk protein group. Co-stimulation with NOB and LF showed stronger degranulation inhibition than with NOB or LF alone. Western blot analysis showed that co-stimulation with NOB and LF significantly downregulated the induction of Akt phosphorylation (p<0.05).

Conclusions: The degranulation response in RBL-2H3 cells was synergistically suppressed by co-stimulation with NOB and LF acting on both Ca^{2+}-dependent and Ca^{2+} independent pathways.

Keyword: Anti-allergic effect , Extract of Shikuwasha (Citrus depressa Hayata) leaves and peel, Nobiletin, Lactoferrin, Degranulation

PAB(T7-84)
Impact of *Nopalea cochenillifera* on the intestinal environment and immune function in mice

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Background and objectives: Kasugai City, Aichi Prefecture, is Japan's largest producer of seedling cacti, and cacti have been used to revitalize the city. In recent years, the Chubu University Cactus Science Society has been established to conduct research on cacti from various perspectives. The Uchiwa cactus (*Nopalea cochenillifera*) is rich in cellulose, hemicellulose, and water-soluble viscous polysaccharides, and has been reported to have various effects on lipid metabolism and have antioxidant activity. The aim of this study was to determine the effects of *N. cochenillifera* on the intestinal environment and immune function. Methods: Five-week-old female BALB/c mice were divided into three groups (n = 8): the C group received AIN-93G as a control diet and the 5% and 10% groups received AIN-93G supplemented with 5% or 10% *N. cochenillifera* respectively. The mice were fed for 28 days. Blood and feces were collected from each group of mice every 7 days. On day 28, in addition to blood and feces, the small intestine, cecum, and large intestine were collected. The cecum content weight, cecum content pH, and fecal mucin were examined to evaluate the intestinal environment. The serum total IgM and total IgG, and fecal total IgA were measured to evaluate the immune function. Results: The dry fecal weight increased with the addition of *N. cochenillifera* beginning on day 7 and increased 1.3-fold in the 5% group, and 1.5-fold in the 10% group, over the entire experimental period. The cecum content pH was significantly decreased in the 5% and 10% groups compared with group C (p > 0.05). Serum antibody levels (total IgM) were significantly decreased on days 14 and 21 in the 10% group, compared with the C and 5% groups (p > 0.05). In contrast, the total IgG levels were increased significantly in the 5% and 10% groups, compared with the C group, at all time points (p > 0.05). The fecal mucin content and total IgA are currently under investigation.

Conclusions: The results suggested that *N. cochenillifera* ingestion regulates the intestinal environment and improves systemic immune function, mainly by increasing IgG levels, in mice.

Keyword: Nopalea cochenillifera, immune function, intestinal environment, immunoglobulins, mice

PAB(T7-85)
Mogrol derived from *Siraitia grosvenorii* activates the bile acid receptor TGR5 and suppresses hyperglycemia in high-fat diet-fed KKAy mice

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Background and objectives: Mogrosides, a group of cucurbitane-type triterpene glycosides, from *Siraitia grosvenorii* are natural sweetener and have various physiological functions such as antidiabetic effect. Mogrol is an aglycone of mogrosides and is the major form absorbed by the body following ingestion of mogrosides. However, the effect of mogrol on the prevention

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of type 2 diabetes has not been elucidated. TGR5 is a G protein-coupled receptor responsive to bile acids. TGR5 is widely expressed the body including pancreatic β-cells and plays a key role in glucose metabolism. Here, we focused on the structural similarity between mogrol and bile acids and examined whether mogrol activated TGR5. We further investigated the antidiabetic effects of mogrol using mice of diabetes mellitus.

Methods: HEK293FT cells were transiently transfected with human TGR5 expression vector and p4xCRE-Luc2P reporter vector, and stimulated with mogrol (50 μM) for 4 h. Five-week-old male C57BL/6J mice or KKAy mice were fed with a standard chow or a high-fat diet (HFD) for 5 weeks. Mice were divided into 4 groups: (i) C57BL/6J were fed a standard chow, (ii) KKAy were fed an HFD, (iii) KKAy were fed an HFD containing 0.01% mogrol, and (iv) KKAy were fed an HFD containing 0.05% mogrol.

Results: We found that mogrol, but not mogrosides, activated TGR5 in HEK293FT cells. We predicted the key amino acid residues of TGR5 that interact with mogrol using *in silico* docking simulation. We then evaluated a series of individual alanine mutants of TGR5 and found that W75 and R80 residues were important for interaction with mogrol, but not deoxycholate. We investigated the antidiabetic effects of mogrol. Mogrol had no effects on body weight or the relative weights of liver, subcutaneous and mesenteric white adipose tissue, or gastrocnemius and quadriceps muscles. Mogrol prevented hyperglycemia and ameliorated glucose tolerance both oral glucose and intraperitoneal glucose tolerance tests in a dose-dependent manner, whereas it did not affect insulin tolerance. Mogrol increased plasma insulin levels in a dose-dependent manner, suggesting that mogrol suppressed pancreatic β-cells dysfunction.

Conclusions: Our results show that mogrol activated TGR5 and suppressed hyperglycemia in HFD-fed KKAy mice.

Keyword: Mogrosides, G protein-coupled receptor, diabetes, sweetener, bile acids

Conflict of Interest Disclosure: The funder (Saraya Co., Ltd.) provided support in the form of salaries for authors (Y.I. and Y.M.), but did not have any roles in the study design, data collection, and analysis.

PAB(T7-86)
The ability of phospholipids extracted from egg yolk and soybean: lipid regulation and intestinal protection

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1. Shanghai Ocean University (China)

Background and objectives: High-fat-and-sugar diets, which are responsible for abnormal lipid metabolism and disruption of the structure of the intestinal ecosystem, have become a common dietary habit. Phospholipids are used to treat chronic diseases such as cardiovascular and cerebrovascular diseases. Phospholipids derived from egg yolks and soybean have significant antioxidant and hypolipidemic abilities.

Methods: This study was to investigate the role and mechanism of egg yolk phospholipids and soybean phospholipids in improving HFD-induced obesity, intestinal short-chain fatty acids and intestinal bacterial structure in rats.

Results: The results showed that PLs reduced liver weight, liver TG and MDA levels, as well as serum ALT, AST, TBA and CRP levels. PLs also showed hypolipidemic and anti-inflammatory effects. Histological examination showed that ingestion of PLs improved liver tissue damage. EPLs increased the decrease in HFD-induced SCFAs and increased acetic acid, propionic acid, isobutyric acid and total SCFAs, thus effectively regulating the environment of intestinal microbial metabolism. In addition, EPLs decreased the ratio of *Firmicutes Bacteria* and the relative abundance of *Streptomyces*, *Arthrobacter* and *Desulfovibrio*, and increased the relative abundance of *Mucor* and *Cellulose bacteria*.

Conclusions: These results suggest that PLs have a good regulatory role in HFD-induced intestinal disease, and the therapeutic benefits of EPLs tended to be more effective than that of SPLs.

Keyword: Phospholipids, Obesity, Gut microbiota, Short-chain fatty acid

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T7-87)
Pyrroloquinoline quinone attenuates fat accumulation in obese mice fed with a high-fat diet, *Daphnia magna* supplied with a high amount of food, and 3T3-L1 adipocytes

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Background and objectives: Obesity is a global health concern resulting from an increase in the consumption of high-energy diets that causes abnormal or excessive fat accumulation in the body. Obesity is often associated with various diseases, such as cardiovascular disease, type 2 diabetes, inflammation, and cancer. Without efficient treatment, an estimated one quarter of the global adult population will be overweight by 2030. However, currently available fat-loss drugs elicit multiple toxic side effects. Pyrroloquinoline quinone (PQQ), a redox-active o-quinone found in various foods and mammalian tissues, has received an increasing amount of attention because of a number of health benefits that can be attributed to its ability to enhance mitochondrial biogenesis. Supplementation with PQQ may help prevent obesity by suppressing body fat accumulation. In the current study, we examined the effect of dietary PQQ on the inhibition of fat accumulation in obese mice, *Daphnia magna*, and adipocyte cells.

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DOI: 10.1159/000530786

Methods and results: Our results revealed that oral PQQ supplementation significantly reduced the accumulation of body fat, particularly that of the visceral fat in the abdominal region in high-fat diet-fed male mice. In *Daphnia*, body fat and body length increased with higher amounts of food; however, PQQ reduced body fat without affecting body growth. PQQ attenuated body fat accumulation under both high-fat and high-calorie consumption conditions. In differentiated 3T3-L1 adipocytes, PQQ increased phosphorylation of AMP-activated protein kinase (AMPK), which is a critical regulator of cellular lipid metabolism and functions as a important regulator of mitochondrial biogenesis, subsequently suppressing lipogenesis. PQQ also promoted mitochondrial biogenesis by inducing the nuclear translocation of peroxisome proliferator-activated receptor-γ-coactivator 1α (PGC1α), which is a master transcription regulator that stimulates mitochondrial biogenesis, in fat cells.

Conclusions: Dietary PQQ could prevent obesity by reducing body fat accumulation via suppressing lipogenesis and promoting mitochondrial biogenesis.

Keyword: Obesity, PQQ, AMPK, PGC1α, Mitochondrial biogenesis

Conflict of Interest Disclosure: The authors have declared no conflict of interest.

PAB(T7-88)
Polyphenol-rich extract from black soybean seed coat ameliorates high-fat diet induced obesity and abnormal feeding rhythm

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Background and objectives: Healthy mice are nocturnal and mainly feed during the dark period, but high-fat diet (HFD) disrupts the daily feeding rhythm and leads to obese. The abnormal feeding rhythm causes obesity through hypothalamic inflammation. We have previously found that polyphenol-rich extract from black soybean seed coat (BE), which contains mainly flavan 3-ols and anthocyanins, suppresses obesity in HFD fed mice. However, the effect of BE on feeding rhythm is not fully understood. The objective of this study is to clarify whether the anti-obesity effect of BE is due to amelioration of the HFD-caused abnormal feeding rhythm.

Methods: C57BL/6J male mice were kept in 12 h-light/dark cycle, and fed a standard diet (SD), HFD, and HFD supplemented with BE at 2% (w/w) for 4 weeks. Body weight and food intake during the light and dark periods were measured throughout the experiment. Expression of inflammation related-factors in the hypothalamus and adipose tissue were evaluated in the mice at the end of the experiment. To find the active compound, BE was separated to three fractions (monomeric flavan 3-ols, procyanidins, and cyanidin 3-O-glucoside) and supplemented them to HFD with 0.5% (w/w) each for 4 weeks. Then, food intake and hypothalamic inflammation were measured.

Results: The SD group mainly fed the diet during the dark period and less during the light period. On the other hand, the HFD group disrupted the diurnal feeding rhythm with the light period hyperphasia, and increased body weight and fat accumulation. BE ameliorated the intake pattern in HFD group close to the SD group. In the HFD group, inflammation in the hypothalamus and adipose tissue was occurred in both acute and chronic stages, while the intake of BE prevented it. Among polyphenols in BE, cyanidin 3-O-glucoside was effectively ameliorated the abnormal feeding rhythm, obesity, and hypothalamic inflammation in HFD-fed mice.

Conclusions: Results from this study provided a novel mechanism in the anti-obesity effect of BE: that the intake of BE prevented HFD-caused hypothalamic inflammation and abnormal feeding behavior, especially inhibiting hyperphasia in the light period. Cyanidin 3-O-glucoside in BE was suggested to be the most effective compound.

Keyword: Feeding rhythm, Obesity, Polyphenol, High fat diet

PAB(T7-89)
Comparative investigation of the effects of beef-tallow and cottonseed oil diets on colonic luminal environment including the ALP activity in rats fed fructo-oligosaccharides

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Background and objectives: We recently reported that fermentable non-digestible carbohydrates including fructo-oligosaccharides (FOS) commonly elevate colonic alkaline phosphatase (ALP) activity and the gene expression of *Alpi-1*, coding for rat intestinal ALP isozyme 1 (IAP-I), in rats fed a high-fat (HF) diet, with concomitantly elevated gut mucins and modulated gut microbiota. We also demonstrated that the elevating effect of FOS on colonic ALP activity was prominent in the lard diet groups compared with the soybean oil and corn oil diet groups. This study aims to investigate whether beef tallow or cottonseed oil diets influences the effect of oligosaccharides on colonic ALP and the luminal environment in rats.

Methods: Male Sprague-Dawley rats were fed a diet containing 30% beef tallow or cottonseed oil with or without 4% FOS for 2 weeks. Colon ALP activity, gene expression, and gut luminal variables including mucins and microbiota were measured.

Results: In the beef tallow diet groups, dietary FOS significantly elevated colonic ALP activity and the expression of *Alpi-1.* However, the cottonseed oil diet groups did not exhibit the elevating effect of FOS on colon ALP. Fecal ALP and mucins were significantly elevated by dietary FOS regardless of dietary fat types, and the effect of FOS was prominent in the beef tallow

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DOI: 10.1159/000530786

diet groups. The fecal ratio of *Lactobacillus spp*. observed in fecal matter was significantly increased by dietary FOS in the beef tallow diet groups, but not in the cottonseed oil diets groups.

Conclusion: The results suggest that the elevating effect of FOS on colonic ALP activity and the gene expression, and colonic luminal variables including mucins was prominent in the beef tallow diet group compared with the cottonseed oil diet groups.

Keyword: Colonic alkaline phosphatase (ALP), Fructo-oligosaccharides (FOS), Beef tallow, Cottonseed oil, Rats

PAB(T7-90)
Anti-inflammatory effect and associated mechanism of djulis in HT-29 human colorectal cancer cells.

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Background and objectives: Inflammatory bowel disease (IBD) is a chronic and repetitive inflammatory disease of the gastrointestinal tract that has two major entities: Crohn's disease and ulcerative colitis. The incidence of IBD in Taiwan is increasing over the past few years. Diet plays an important role in the onset and progression of IBD. Western eating habits are closely associated with the high incidence of IBD. Djulis (*Chenopodium formosanum*) is a cereal crop native to Taiwan. Studies have confirmed that the bioactive compounds in djulis, such as betalains, rutin, chlorogenic acid and kaempferol, are directly related to its anti-inflammatory effect. The hull of djulis is usually recognized as an agricultural waste. However, recent studies have indicated that the hull of djulis contains a large amount of active compounds, which are important sources of functional components for the food and biotechnology industry.

Methods: This study investigated the anti-inflammatory effect and associated mechanism of djulis on IBD in a cell model. Whole djulis was extracted with 70% ethanol and intervened at different concentrations (0, 20, 40, 60, 80, 100 μg/mL) and time (24, 48 and 72 h) in inflammatory HT-29 human colorectal cancer cells induced by lipopolysaccharides (LPS) and tumor necrosis factor (TNF)-α. Inflammation-related proteins and cytokines were analyzed to elucidate the mechanism of djulis extracts.

Results: Low-dose (20 and 40 μg/mL) djulis extracts tended to promote cell proliferation, while high-dose (80 and 100 μg/mL) djulis extracts significantly inhibited cell proliferation. LPS- and TNF-α-induced HT-29 cells showed high expression of pro-inflammatory proteins. High-dose (100 μg/mL) djulis extract significantly decreased the expression of cyclooxygenase-2 (COX-2) and nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) compared to control group. There was no difference in COX-2 expression between high-dose and blank groups. The levels of TNF-α, interleukin (IL)-6 and IL-8 were significantly lower in high-dose (80 and 100 μg/mL) groups compared to control group.

Conclusions: These results suggest that djulis may have the potential to inhibit the development of IBD via modulating NF-κB signaling pathway.

Keyword: Djulis, Ethanol extracts, Inflammatory bowel disease, Anti-inflammation

Conflict of Interest Disclosure: No potential conflict of interest is relevant to this article.

Further Collaborators: No further collaborators.

PAB(T7-91)
Macro and Micro Characterization of Antioxidant Protein Hydrolysates from Hemp (*Cannabis sativa* L) seeds.

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Background and objectives: Green industries, such as industrial agricultural hemp (*Cannabis sativa* L.), represents a new source of sustainable plant protein and bioactive peptides that can exert biological functions and promote health. The objective of this study was to obtain bioactive peptides from hemp protein hydrolysates (HPHs), to analyse their macro- and micronutrient composition and to evaluate antioxidant activity of these functional protein by-products of agri-food industry.

Methods: A hemp protein isolate (HPI), obtained from hemp defatted flour (HDF), was hydrolyzed by Alcalase and Flavourzyme enzymes, both food-grade endoproteases, under specific conditions. The resulting HPHs were chemically characterized in macro and micro-nutrients and their antioxidant capacity were evaluated by *in vitro* cell-free experiments owing to their measure of capacity to sequester DPPH free radical, β-carotene, and reducing power.

Results: Characterization and comparison of nutritional composition (macro and/or micronutrients) between all protein products showed than the chemical composition of HPHs was like HPI. Results showed that amino acid composition of the hemp protein products broadly complies with the adult requirements established by the Food and Agriculture Organization/World Health Organization/United Nations University (FAO/WHO/UNU) for indispensable dietary amino acid. Moreover, *in vitro* cell-free experiments led to the identification of two bioactive HPHs, HPH20A and HPH60A+15AF, which showed an IC50 value like positive control (BHT), in order to evaluate the hemp peptides with antioxidant activities.

Conclusions: Plant protein-based products supplemented in functional food and nutraceuticals are expected to grow considerably in the next years. Plant proteins, usually, present insufficient levels of at least one or even more essential amino acids thus limiting their biological value. However, antioxidant

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

peptides in HPHs presented a balanced amino acid profile and a digestibility higher than intact proteins, hence, these results show that HPHs could be considered as an effective option within the functional food generation and would support their use in future clinical food trials.

Keyword: Hemp, Protein hydrolysates, Bioactive compounds, Functional foods, Antioxidant activity

PAB(T7-92)
Effect of Fish Oil Supplementation in Preventing Paternal Obesity and Improving Offspring Metabolic Health

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Background: Currently in the United States, about 2 in 3 males of reproductive age are either overweight or suffer from obesity. This is critical since both animal and human studies provide strong evidence that children of obese fathers have an increased risk of obesity, regardless of mother's weight. Fish oil (FO) derived from fatty fish contains omega-3 polyunsaturated fatty acids and is beneficial in regulating body weight and lowering inflammation. FO reduces adverse effects of maternal obesity. Still unknown, however, is the role of FO consumption in paternal metabolic health and the subsequent impact on offspring. Hence, our objective is to identify mechanisms of FO that reduce paternal obesity and thereby improve metabolic health of offspring.

Methods: Male mice were fed high fat (HF) diets either with or without FO along with low fat (LF) diet for 10-weeks (preconception phase). They were then mated with a healthy female mouse to prevent effects of maternal obesity. All male and female offspring (n=12 per group) were on chow diets and followed for 16 weeks. Body weight was measured on day 1,7 and then weekly. Glucose and insulin tolerance tests were performed during the 12th week of offspring age.

Results: Body weight (BW) of fathers were comparable after 10 weeks on the respective diets. Male and female offspring born to HF fathers had higher BW on day 1 and 7 compared to offspring of LF fathers. Further, offspring of FO fathers had significantly reduced BW at these timepoints than offspring of HF fathers. Offspring BW were similar between weeks 3 - 8. Interestingly, offspring of FO fathers had reduced body weight between weeks 8-16. Offspring of HF fathers had significantly higher glucose intolerance than offspring of LF fathers, but the offspring of FO father had lower glucose intolerance than offspring of HF fathers. Lastly, offspring of FO fathers had better insulin sensitivity. Currently underway are genomic analyses of adipose tissue to better understand mechanisms.

Conclusion: These results are expected to provide strong scientific evidence for fish or FO consumption in fathers to improve their metabolic health and ultimately reduce rates of childhood obesity.

Keyword: Fish oil, Paternal obesity
Conflict of Interest Disclosure: None
Further Collaborators: None

PAB(T7-93)
Anti-hyperglycemic effect of theaflavins in spontaneously diabetic Torii rats

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Background and objectives: Type Ⅱ diabetes mellitus, characterized by hyperglycemia and inadequate insulin secretion, causes mortality and morbidity. Improvement of hyperglycemia at pre−diabetic stagesis one of appropriate strategies for preventing the development of diabetes. In this regard an alternative medicinal food is acceptable to overcome these issues. According to previous finding that theaflavins, a non−absorbable condensed catechins, suppressed intestinal glucose transporters in Caco−2 cells, we tried to investigate whether theaflavins showed *in vivo* anti−hyperglycemic effect in spontaneously diabetic Torii rats. This study also investigated the underlying mechanism of the effect, using human colorectal adenocarcinoma cells.

Methods: A long−term administration of a mixture of theaflavins <25 mg/kg/day> for 20 weeks was performed to 8−week−old SDT rats. Measurements of oral glucose tolerance test and blood glucose level were performed in every 2 weeks. At the end of this protocol, glucose transporters as well as GLP−1 secretion and dipeptidyl peptidase−IV activity were examined by ELISA assays. NCI−H716 cell experiments were performed to clarify the mechanism of theaflavin−induced incretion secretion.

Results: During the 20−week protocol of theaflavin administration to SDT rats, an impaired OGTT in control group was significantly ameliorated in the theaflavin group, along with the increased insulin level and reduced BGL <0−120 min : control group, 598 ± 6 mg·h/dL; theaflavin group, 455 ± 18 mg·h/dL, $p < 0.01$>. At 28−week−old, an increased GLP−1 secretion in the jejunum membrane was observed in the theaflavin group, while no changes in glucose transporter expression and DPP−4 activity were obtained. This strongly suggested that theaflavins have anti−hyperglycemic potential *in vivo* through the incretin secretion in small intestine. The incretion secretion stimulated by theaflavins were involved in the incorporation process of theaflavins into membrane cells, leading to an AMPK activation toward GLP−1 secretion.

Conclusions: The present study demonstrated that non−absorbable theaflavins have anti-hyperglycemic potential through the AMPK−mediated GLP−1 secretion.

Keyword: Theaflavin, Anti-diabetes, Anti-prediabetes, GLP-1

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-94)

Cognitive benefit of breakfast combined with caffeinated coffee and malt drink (a randomized placebo-controlled double-blind crossover human study)

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Background and objectives: Attention and memory are important cognitive functions and caffeine and glucose have been reported to improve these functions, respectively. However, information is limited when these components were consumed in regular diet. In the present study, we evaluated the effects of coffee and malt beverage, as sources of caffeine and glucose, on cognitive functions, when these consumed in breakfast.

Methods: A randomized, placebo-controlled, double-blind, crossover study was conducted in 19 healthy adult subjects (11 males and 8 females) in their 30s-40s. Test meal (259 kcal) was composed of bread rolls and salad with coffee containing 74 mg of caffeine (NESCAFÉ Excella) and a malt beverage (Nestlé MILO) containing 9.87 g of carbohydrate dissolved in 150 ml of cow's milk, or isocaloric control meal adjusted with butter and replacing from test drink to cocoa drink containing 0.75 g of carbohydrates dissolved in 150 ml of cow's milk was served as breakfast. Cognitive function test battery using Cognitrax, Uchida-Kraepelin test for simple calculation, and VAS questionnaire for sleepiness, alertness and mood were administered before and after each meal. The washout period was set for one week.

Results: The mean correct response time of part-2 of 4-part continuous performance test (FPCPT) after test meal was 26.9 ms shorter than the one after control meal ($p<0.05$). Although significant improvements were found in executive function, working memory, sustained attention, and number / time of correct responses of shifting attention test (SAT) after test meal ($p<0.05$), no increase were found after isocaloric control meal. Sleepiness, alertness and mood were also improved just after test meal ($p<0.05$).

Conclusions: A breakfast with caffeinated coffee and a malt beverage may be beneficial to improve not only sleepiness and mode but also cognitive functions, such as executive function, working memory, and sustained attention, even if doses of caffeine and glucose sources are moderate. The trial was registered with UMIN Clinical Trails Registry, number 000046600.

Keyword: Coffee, Caffeine, Glucose, Cognitive functions, Breakfast

PAB(T7-95)

Diets modulate the age-dependent decline of associative learning in *Caenorhabditis elegans*

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Background and objectives: Dietary intervention is a practical, non-invasive approach to ameliorate age-dependent decline of brain functions. We aimed to reveal the causality and molecular mechanisms of how diets affect the age-dependent decline of associative learning.

Methods: To investigate age-dependent phenotypes, we used *C. elegans*, whose lifespan is only a few weeks. *C. elegans* exhibits an associative learning behavior of temperature and food called thermotaxis. Thermotaxis ability declined within five days of adulthood. To investigate the dietary effects on thermotaxis decline, we screened 51 different lactic acid bacterial strains mixed with the regular bacterial diet, *E. coli*. We further evaluated the effect of select lactic acid bacteria on growth and lifespan.

Results: The screen of lactic acid bacteria identified species that ameliorated age-dependent thermotaxis decline. Furthermore, we found that some of those bacteria did not affect the growth or lifespan of *C. elegans*, compared to the regular diet, *E. coli*.

Conclusions: Our results demonstrate that select lactic acid bacteria can regulate neuronal functions independently of the organismal lifespan. We propose that the combination of *C. elegans* and its bacterial diet is ideal for studying dietary modulation of age-dependent phenotypes. Further mechanistic studies may shed light on the gut-brain axis in humans.

Keyword: Aging, Lactic acid bacteria, Caenorhabditis elegans, Learning and Memory, Diet

Conflict of Interest Disclosure: This study was funded by Megmilk Snow brand Co. Ltd..

PAB(T7-96)
Long-term intake of *perilla* seed oil improves bone mineral density in healthy adults

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Background and objectives: This study investigated the effects of long-term intake of *perilla* seed oil (PO), a rich source of a-linoleic acid (LNA), on bone mineral density (BMD) and serum bone metabolism markers in healthy Japanese adults.

Methods: Fifty-two participants (mean age 54.2±6.4) were randomly divided into placebo (n=25) and PO (n=27) groups. PO group received daily 7.0 mL of PO, while placebo group received olive oil daily for 12 months. At baseline and after 3, 6, and 12 months, the BMD of the right calcaneus, serum levels of tartrate-resistant acid phosphatase 5b (TRACP-5b), and bone alkaline phosphatase (BALP) were measured. Additionally, LNA levels in the erythrocyte plasma membrane (RBC-PM), serum levels of biological antioxidant potential (BAP), and diacron reactive oxygen metabolites (d-ROM) were evaluated.

Results: Compared with placebo group, the BMD levels at 6- and 12-months increased in PO group. Serum TRACP-5b levels decreased significantly in PO group compared to that in placebo group, while serum BALP levels remained unchanged. Moreover, RBC-PM LNA levels and BAP/d-ROM ratios increased significantly in PO compared with placebo group. At 12-months, BMD levels were significantly correlated with RBC-PM LNA levels.

Conclusions: Long-term PO intake may improve age-related BMD decline in Japanese adults by suppressing bone resorption and increasing LNA levels.

Keyword: Perilla seed oil, bone mineral density, bone resorption, alpha-linolenic acid

Conflict of Interest Disclosure: The authors declare that they have no conflict of interest.

PAB(T7-97)
Plasticity in taste preference to bitterness and astringency requires DAF-16/FOXO in the AIY interneurons in *Caenorhabditis elegans*

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Background and Objectives: Bitterness is a gustatory feeling identified by taste receptors, whereas astringency is a mouth sensation including dryness or convergence. The inclination for bitterness or astringency in people might shift based on previous eating experiences. However, the cellular and molecular mechanisms underlying plasticity in taste preference remain largely unexplored. We investigated preference plasticity to bitter and astringent tastes using *Caenorhabditis elegans* as a model animal in this study.

Methods: Young adult animals of wild-type (N2) or mutant *C. elegans* strains were subjected to behavioural assays. Drop assay was used to examine avoidance behavior, in which a drop of each test compound's solution was dropped on the medium near the head of a moving worm. Synchronized larvae were raised with or without epigallocatechin gallate (EGCG) until they reached adulthood to test behavioral adaptability against it.

Results: *C. elegans* showed avoidance behavior against several bitter and astringent compounds. Depending on pre-exposure to EGCG throughout larval stages, worms exhibited decreasing avoidance of EGCG, which triggered astringency and bitterness. Anti-EGCG behavioral plasticity was disrupted in mutants with defective AIY interneurons. Furthermore, *daf-16*/FOXO mutants with aberrant AIY neurons were likewise plasticity deficient. The phenotype of the *daf-16* mutant was rescued by the *daf-16* transgene driven by AIY-specific promoter.

Conclusions: Genetic analyses revealed that experience-dependent plasticity in preference to EGCG requires a transcription factor DAF-16/FOXO in the AIY interneurons in *C. elegans.*

Keyword: bitterness, astringency, taste preference, EGCG, C. elegans

PAB(T7-98)
Anti-obesity effect of sesaminol and its mechanism

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Background and objectives: Sesaminol (3,4-methylenedioxy phenol) is a one of sesame lignan found in sesame seeds, and it has a strong antioxidant activity and anti-cancer effect. Recently, we have already shown that sesaminol has a preventive effect on Parkinson's disease. Therefore, in this study to clarify the new physiological effects of sesaminol, we investigated the anti-obesity effect and its mechanism in an *in vitro* experimental system using 3T3-L1 preadipocytes.

Methods: 3T3-L1 preadipocytes were incubated in Dulbecco's modified Eagle's medium (DMEM) containing 10% fetal bovine serum (FBS). At 2 days after reaching confluence (day 0), adipocyte differentiation was induced with 0.25 µM dexamethasone, 0.5 mM 3-isobutyl-1-methylxanthine, and 0.2 µM insulin in DMEM supplemented with 10% FBS for 2 days. Then, the cells were treated with 0.2 µM insulin in DMEM

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DOI: 10.1159/000530786

supplemented with 10% FBS for another 2 days and cultured for an additional 4 days in DMEM with 10% FBS. The intracellular triglyceride (TG) accumulation amount and the activity of glycerol-3-phosphate dehydrogenase (GPDH), a rate limiting enzyme of as the TG synthesis were measured. Furthermore, the expression of transcriptional regulators (PPARγ, C/EBPα, C/EBPβ) involved in adipose differentiation were examined using Western blotting and real-time quantitative PCR.

Results: Sesaminol significantly suppressed intracellular TG accumulation and GPDH activity. In addition, to clarify at which stage of differentiation that sesaminol is acting, an experiment was conducted by changing the sample addition period during the induction of differentiation. When sesaminol was added on Day 0, intracellular TG accumulation decreased significantly. However, the addition of sesaminol after Day 2 had no effect on the intracellular TG level. On the other hand, regarding the expression of transcriptional regulators involved in adipose differentiation, the addition of sesaminol significantly reduced both protein and gene levels at PPARγ and C/EBPα, but C/EBPβ did not change at the gene level and decreased at the protein level.

Conclusion: It was suggested that sesaminol suppressed the differentiation of adipocytes through the posttranscriptional regulation of C/EBPβ.

Keyword: Sesaminol, Anti-obesity, 3T3-L1 preadipocyte, Posttranscriptional regulation of C/EBPβ

PAB(T7-99)
Intestinal metabolism of DHA-bound phosphatidylcholine with different binding positions in rats

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Background and Objectives: Docosahexaenoic acid (DHA) is one of the n-3 essential fatty acids, especially important for the development of the brain and the central nerve function. Major dietary source of DHA is fish oil, which contains DHA in the form of triacylglycerol. Recently, marine phospholipids such as krill oil, marine microalgae and fish roe have attracted attention as another DHA source. Previously, we reported that phospholipids were better dietary source of DHA than triacylglycerols to increase the post-prandial level of systemic DHA-bound phospholipids, which may enhance the DHA uptake in the brain[1]. In this study, the influence of the binding position of DHA in phospholipids on the digestion and metabolism in the small intestine was investigated.

Methods: Phosphatidylcholine (PC) containing DHA either at sn-1 or sn-2 position (1-DHA-PC and 2-DHA-PC) was administered via duodenal tubing to conscious thoracic lymph-cannulated rats. Absorbed lipids in the lymph were fractionated using thin-layer chromatography and DHA and other fatty acids were determined with gas chromatography. Furthermore, DHA-bound phospholipids were digested with phospholipases *in vitro* to determine the chemical form of DHA as digestion products.

Results: DHA was mainly found as triacylglycerol esters in the lymph after administration, similarly to our previous report. The lymphatic phospholipid fraction appeared after 2-DHA-PC administration contained significantly higher level of DHA than that after 1-DHA-PC administration. *In vitro* digestion of 1-DHA-PC yielded mainly lyso-DHA-PC, while 2-DHA-PC liberated most of DHA as free fatty acid. Interestingly, digestion with pancreatin showed the suppression of hydrolysis of DHA at sn-2 position compared with the digestion with authentic pancreatic phospholipase A2.

Conclusion: Our result indicated that 2-DHA-PC was preferentially used to synthesize DHA-bound PC in the enterocyte compared with 1-DHA-PC. Digestion of DHA containing PC by the enzyme other than phospholipase A2 may be responsible for such differences.

Keyword: phosphatidylcholine, DHA, phospholipase, lymph, intestinal metabolism

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PAB(T7-100)
Effects of feeding diets supplemented with low-calorie sweeteners on energy metabolism in rats.

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Background and objectives: Low-calorie sweeteners are expected to reduce energy intake and decrease body weight. Erythritol, for example, is considered an almost zero calorie sweetener due to its absorption and metabolism mechanisms. However, there are reports that intake of artificial sweeteners (aspartame, acesulfame K, etc.) affects energy metabolism via incretin secretion, and further detailed studies on the effects on energy metabolism are considered necessary. In this study, we examined the effects on energy metabolism in rats fed diets with two different energy compositions of erythritol or erythritol with aspartame and acesulfame K.

Methods: Male rats (SD, 4weeks) were assigned into six groups: normal diet group (N), normal diet group with erythritol (NE), normal diet group with erythritol plus aspartame and acesulfame K (NP), high fat diet group (F), high fat diet group with erythritol (FE), and high fat diet group with erythritol plus aspartame and acesulfame K (FP). These groups were given each experimental diet for 28 days. The rats were then sacrificed and the plasma and various tissues were collected.

Results: Total energy intake did not differ between the N, NE, and NP groups and F, FE, and FP groups. Total fecal lipid weight was significantly higher in NE group compared to N group, and tended to be higher in FE group compared to F group. Plasma

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

triglycerides (TG), liver TG, and total visceral fat tended to be lower in NE group compared to N group, and in FE group compared to F group. These results suggest that erythritol intake may suppress lipid absorption from the intestinal tract and lower lipid content in the liver. On the other hand, total cholesterols in the liver was significantly higher in FP group compared to F and FE groups.

Conclusions: Low-calorie sweeteners may affect energy metabolism even when they are not a source of energy. In addition, even the same low-calorie sweetener may have different effects on energy metabolism with different feed compositions, suggesting that the effects of low-calorie sweeteners on energy metabolism may need to be studied in detail for each feed.

Keyword: erythritol, low calorie sweeteners, energy metabolisms, fat, rats

PAB(T7-101)

Bioactive iminosugar 1-deoxynojirimycin reverses neuronal insulin resistance and alleviates tau hyperphosphorylation: an in vitro study using insulin-resistant neuroblastoma

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Background and Objectives: Insulin signaling has been shown to be impaired in the brain of patients with Alzheimer's disease (AD). This prompted a growing search for bioactive compounds to maintain healthy neuronal insulin sensitivity. 1-Deoxynojirimycin (DNJ), a mulberry leaf-derived iminosugar with anti-diabetes properties, was shown to reverse obesity-induced dysregulation in adipose insulin signaling and present at a substantial level in brain following oral intake[1]. Hence, this study was aimed to investigate the ameliorative effect of DNJ against insulin resistance and AD-like tauopathy in the cell culture model of neuronal insulin resistance.

Methods: To induce an insulin-resistant state (INS-R), SK-N-SH cells (human neuroblastoma) were grown in the medium containing high insulin concentration (250 nM, 24 h). INS-R cells were then treated with DNJ (2.5, 5, or 10 µM) for another 24 hours. Meanwhile, cells in the Control group were grown without insulin or DNJ. Finally, all cells were stimulated with insulin (100 nM, 30 min) before being collected for RT-qPCR and western blotting analysis.

Results: INS-R cells showed lower expression of genes related to the insulin signaling cascade, glucose transport, and β-amyloid clearance. They also had a more blunt response to insulin, as shown by lower phosphorylation of insulin receptor (IR), protein kinase B (AKT), and glycogen synthase kinase 3 beta (GSK3B) at Tyr1146, Ser473, and Ser9 site, respectively, upon insulin stimulation. This occurs alongside an increase in tau phosphorylation at Ser202, which is one of the hallmark features of AD. DNJ treatment at 5 and 10 µM was able to reverse insulin-resistant-induced dysregulation in gene expression while also promoting the phosphorylation of IR and activation of AKT/GSK3B pathway. More importantly, DNJ lowered tau phosphorylation, presumably by inhibiting GSK3B activity via its phosphorylation at Ser9.

Conclusion: Our data suggests how DNJ exerts a neuroprotective effect by regulating neuronal insulin signaling, thus providing basis for its use as a multi-target therapy for diabetes and AD. Currently, we are analyzing the expression of other proteins related to neuronal insulin signaling and AD pathogenesis to gain a more comprehensive insight into DNJ's neuroprotective potential.

Keyword: 1-deoxynojirimycin, iminosugar, mulberry leaf, neuronal insulin resistance, tau hyperphosphorylation

Reference: 1. Parida et al., 2020, *Food Funct*., 11, 3926-3940.

PAB(T7-102)

Cancer chemopreventive potential of protein hydrolysates from black soldier fly (*Hermetia illucens*) larvae residue

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Background and objectives: Cancer chemoprevention involves the use of natural compounds to either delay or stop cancer formation. These compounds can prevent DNA mutation, enhance the antioxidant system and reduce inflammation resulting in the suppression of each stage of carcinogenesis. Nowadays, insect consumption has become a popular trend because edible insects are rich in various essential nutrients, are environmentally sustainable and quite palatable. Black soldier fly larvae (BSFL) have been incorporated into numerous commercially-produced food products for their high protein content. Our previous study reported that glutelin was the most effective protein among BSFL proteins. Several recent studies have reported that protein hydrolysates obtained from diverse sources, including insects, exhibit various biological and pharmacological activities. The present study aims to investigate the cancer chemopreventive capacity of glutelin hydrolysates from BSFL residue and assess their potential antioxidant, anti-inflammatory, antimutagenic and anticarcinogenic activities.

Methods: Glutelin was prepared from defatted BSFL powder via alkali extraction and then digested by 3%(w/w) alcalase at pH 8, 50°C for 4 hrs. Glutelin hydrolysate (GH) was further fractionated by ultrafiltration (MWCO 3, 10 and 30 KDas) to obtain GHH30, GH10-30, GH3-10 and GHL3. Cancer chemopreventive capacity was determined by assessing antioxidant (FRAP, DPPH and ABTS assays), anti-inflammatory

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(%nitric oxide production in RAW 264.7 cell line), antimutagenic (Ames test) and anticancer (liver (HepG2), lung (A549) and colon (SW480) cancer cell lines) activities.

Results: GHH30 containing more than 30 KDa peptides exhibited the greatest antioxidant value using FRAP, DPPH and ABTS assays when compared with GH and other fractions. Furthermore, GHH30 inhibited mutagenicity induced by aflatoxin B1 in *Salmonella typhimurium* strain TA98. GHL3 containing fewer than 3 KDa peptides could effectively reduce nitric oxide production induced by lipopolysaccharide in RAW 264.7 cell lines and inhibit the growth of HepG2, A549 and SW480 cells.

Conclusion: Large peptides isolated from GH of BSFL exhibited antioxidant and antimutagenic activities, while small peptides exhibited anti-inflammatory and anti-cancer activities. Black soldier fly larvae protein hydrolysate may be considered an alternative source of cancer chemoprevention. Importantly, the chemopreventive peptides from BSFL are presently under going further investigation.

Keyword: Black soldier fly larvae, Insect protein hydrolysates, Antioxidant activity, Anti-carcinogenicity, Chemoprevention

PAB(T7-103)
The estimation of the energy value of allitol using growing rats

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Background and objectives: Allitol is rare sugar alcohol obtained by reducing d-allulose (d-psicose) and can be found in *Itea*, a deciduous shrub of the family Saxifragaceae, with d-allulose. Our previous study reported that dietary allitol has the same anti-obesity effect as d-allulose or erythritol. Because the energy values of d-allulose and erythritol were both 0 kcal/g, the energy value of allitol is also expected to be 0 kcal/g. This study has investigated the available energy of allitol for rat growth. Moreover, the degree of intestinal fermentability of allitol from the cecal morphology of rats has been examined.

Methods: Sixty-six male Wistar rats (3 weeks old) were randomized into eleven groups of six rats. One group of rats was sacrificed at the beginning (day 0 control). Each remaining group of rats received 7 g of high protein diet (basal diet) daily, to which a fixed amount of sucrose, maltitol, or allitol (0.4–1.2 g) was added for 20 days. On the final day, the rats were sacrificed and residual food in the digestive tracts was discarded. Body energy was determined by quantifying the fat (9.4 kcal/g) and protein (4.0 kcal/g) content of the carcass. To calculate the change in body energy content of each animal over 20 days, the difference between the average energy content of rats and the average value of the day 0 control was determined.

Results: Body energy gain increased with the increase in test carbohydrates and was higher in the rats fed with a sucrose added diet than those in the other rats. The cecal content and surface area were higher in the order of rats fed with allitol, maltitol, and sucrose. From increases in body energy, regression lines have been calculated. One gram of sucrose, maltitol, and allitol produced a net gain of 1.85, 1.02, and 0.94 kcal, respectively. The energy values of maltitol and allitol were estimated at 2.17 and 2.05 kcal/g, respectively.

Conclusion: This study has demonstrated that allitol is a sugar alcohol that provides about 2 kcal/g similar to maltitol. Furthermore, allitol was found to have stronger cecal fermentability than maltitol.

Keyword: Allitol, Rare sugar, Anti-obesity effect

PAB(T7-104)
Establishment of a fatty liver model system using the Hepa 1-6 strain and the effects of extracts from plants with high polyphenol content on fat accumulation

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Background and objectives: NAFLD is caused by daily dietary habits, and it is important to prevent and treat it because it can lead to cirrhosis and liver damage in cases of severe disease. In this study, we established an experimental screening system using mouse liver cancer cells, and investigated the effect of a plant-derived extract with high polyphenol content on the accumulation of triacylglycerol (TAG) in hepatocytes.

Methods: Mouse liver cancer cells, Hepa 1-6, were used in the experiments. DMEM containing 10% FBS was used and incubated (37°C, 5% CO_2). The cells were incubated in medium containing oleic acid for 48 hours; fixed in formalin; and then incubated in Oil Red solution. Absorbance was measured at 530 nm. Simultaneously, TAG was extracted from the cells and quantified. Itadori (*Fallopia japonica*) was used as the plant with high polyphenol content. The effect of the plant's extract on TAG accumulation was examined by measuring absorbance by using the Oil Red staining method after 48 hours of incubation in medium supplemented with oleic acid and Itadori leaf extract. In addition, the expression levels of the genes of *CD36, FAS, DGAT1, DGAT2, MCAD,* and *ACOX1* were determined by RT-PCR to analyze the expression of lipid metabolism-related factors.

Results: The addition of fatty acids to the medium resulted in Oil Red staining in an incubation oleic acid concentration-dependent manner, and increased absorbance at 530 nm. Intracellular TAG measurements showed a positive correlation between absorbance and TAG concentration (R=0.999). The expression levels of the *CD36, FAS, DGAT1, DGAT2,* and *ACOX1* genes increased with increasing oleic acid concentrations. On the other hand, TAG accumulation, significantly reduced in a concentration-dependent manner upon the addition of Itadori leaf extract at all oleic acid concentrations. Both *DGAT1* and *DGAT2* gene expression levels decreased, and the expression of the *FAS* gene significantly increased, while those of the *MCAD* and *ACOX1* genes significantly upregulated upon the addition of Itadori leaf extract.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: The addition of oleic acid to the Hepa 1-6 cells affected TAG synthesis. In contrast, the addition of Itadori leaf extract was thought to inhibit intracellular TAG accumulation.

Keyword: fatty liver, Hepa 1-6, Itadori (Fallopia japonica), triacylglycerol

PAB(T7-105)
Diosgenin, a natural steroidal saponin, suppresses COX-2 and mPGES-1 via the glucocorticoid receptor and improves LPS-induced liver injury in mice

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Background and objectives: Prostaglandin (PG) E_2, one of the pro-inflammatory lipid mediators, induces acute and chronic inflammation. In some pathophysiological conditions, cyclooxygenase (COX)-2 and microsomal PGE synthase (mPGES)-1 are transiently induced, leading to PGE_2 overproduction. We previously found novel anti-inflammatory and anti-carcinogenic effects via the downregulation of COX-2 and mPGES-1 in a wild yam, *Dioscorea japonica*. Additionally, diosgenin, a steroidal saponin, was one of the potential substances in wild yam. In this study, we examined whether diosgenin suppressed COX-2 through the glucocorticoid receptor (GR), and ameliorated the inflammation in the lipopolysaccharide (LPS)-induced mouse acute liver injury.

Methods: Human non–small-cell lung carcinoma A549 cells were incubated with diosgenin (100 or 1000 nM), and with/without RU486 (0-100 nM) as GR antagonist. Mouse models of acute liver injury induced by LPS (10 mg/kg/day i.p.) were administered diosgenin (100 μmol/kg/day i.p.). Protein and mRNA expression levels were analyzed by western blotting and quantitative RT-PCR, respectively. Immunocytochemistry and immunohistchemistry were carried out by multiple immunofluorescence microscopy using specific antibodies against COX-2, mPGES-1, nuclear factor-kappa B (NF-κB; a potent transcription factor of COX-2) and F4/80 (a macrophage marker).

Results: We demonstrated that diosgenin suppressed COX-2 in A549 cells via NF-κB translocation and the effects were reversed by RU486. In LPS-induced mouse liver injury, COX-2 and mPGES-1 were induced and localized in sinusoidal macrophages and endothelial cells; however, diosgenin administration significantly suppressed *Ptgs2* (COX-2) and *Ptges* (mPGES-1) *expression* and decreased COX-2 and mPGES-1 immunopositive cells in the sinusoids. Multiple immunohistochemical analyses showed that diosgenin had an effect on COX-2 and mPGES-1, particularly in the macrophages.

Conclusions: These findings suggested that diosgenin downregulated COX-2 and mPGES-1 via the GR and suppressed COX-2 and mPGES-1 in the macrophages of LPS-induced acute mouse liver injury. Diosgenin may be an effective alternative therapy as a food-derived bioactive compound; it acts in a cell-specific manner without any adverse effects, such as thrombosis.

Keyword: cyclooxygenase-2, microsomal prostaglandin E synthase-1, anti-inflammation, steroidal saponin, liver injury

Conflict of Interest Disclosure: non

PAB(T7-106)
Amaranth-pearl millet-chickpea composite flour based nutritious gluten-free cookies with potential antioxidant activity and bioactive compounds

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Background and Objective: Development of fortified bakery and pasta products from composite flours is the latest trend in bakery industry to overcome the nutritional disadvantages of refined wheat flour. Amaranth, a pseudocereal, and a front-runner in gluten-free bakery, has high nutrient, phenolic and flavonoid content with antioxidant activity. The objective of the present study was to develop gluten-free multi grain chocolate chip from composite flour of raw and popped amaranth, pearl millet and chick pea flour.

Methods: Phase I involved characterization of the individual flours followed by standardization of composite flour (CF) and cookies by mixture experiment and multi-factorial experiment design, respectively. In phase II, CF and cookies were analyzed for proximate and nutrient composition, total phenolic content (TPC), flavonoid content (TFC) and antioxidant activity by DPPH and FRAP. Shelf life studies were conducted. Consumer survey was done in phase III.

Results: CF and cookies showed following values-Protein 14%, 7.6%; dietary fibre 7.4%, 5.6%; iron 9.3 mg/100g, 6.2 mg/100g; calcium 89 mg/100g, 65 mg/100g; lysine 0.99g/100g, 0.53g/100g; TPC 277 mgGAE/100g, 315.56 mgGAE/100g and TFC 312.5 mgQE/100g, 250 mgQE/100g respectively. EC_{50} by DPPH was 22.78 mg/ml and 12.99 mg/ml and FRAP value was 151 mg GAE/ 100g and 204mg GAE/100 for CF and cookies respectively. Gluten content was found to be well below the threshold of 20 ppm in both CF and cookies. Shelf life of cookies was 5 months in a laminate of BOPP-metPET-BOPP. Consumer survey showed high acceptability of the product with 94.7% of the subjects liking it.

Conclusions: The study made a successful attempt in developing gluten-free cookies with good nutritional value and high overall acceptability. The cookies had high macro and micronutrient content, good total phenolic and flavonoid content and high antioxidant activity, thus providing possible health benefits. Consumer survey data showed that the cookies were accepted by all age groups. Thus the product can be used as a healthy alternative of refined wheat flour cookies by the public. Being gluten free it can even be used in the dietary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

management of celiac disease. It is also a step towards processing and utilization of an indigenous pseudocereal.

Keyword: Amaranth, Celiac, Gluten free, Pearl millet, Chick pea

Conflict of Interest Disclosure: This is part of PhD work of the first author. Only one section has been published in a journal. Part of work was presented in NIN conference in poster format.

Conflict of interest: none

PAB(T7-107)
Molecular basis of host resistance to pathogens conferred by feeding *Bacillus subtilis* var. natto in *C. elegans* as a surrogate model

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Background and Objectives: Methodologies and measures for prevention and alleviation of infectious diseases via familiar and inexpensive food products are desired, in addition to pharmaceuticals. We previously reported that *Bacillus subtilis* var. natto increases host resistance to Gram-positive bacteria using *C. elegans* as a human surrogate model. This study was conducted to elucidate the molecular mechanisms by which *B. subtilis* (natto) confers resistance to bacterial infection using *C. elegans*.

Methods: Wild-type *C. elegans* (N2) and mutants for genes related representative defense response pathways such as TGF-β, p38 MAPK and Insulin/IGF-1 signaling (IIS) pathways were used. Synchronized larvae were grown on agar medium coated with a standard diet of nonpathogenic *Escherichia coli* strain (OP50) or *B. subtilis* (natto) until they reached to the adult stage, and then transferred to medium coated with *Staphylococcus aureus* for survival analysis. Survival rates were calculated by the Kaplan-Meier method, and differences in survival rates were compared by the log-rank test.

Results: In the wild-type and *dbl-1*/TGF-β mutant animals, *B. subtilis* (natto)-fed group showed significantly shorter survival time in comparison with the OP50 (control)-fed group. In contrast, there was no significant difference in the survival times between control-fed and *B. subtilis* (natto)-fed *skn-1*/Nrf mutant worms upon *S. aureus* infection. These results suggest that SKN-1 is required for the *B. subtilis* (natto)-induced host resistance to *S. aureus*.

Conclusions: *B. subtilis* (natto) could increase host resistance to *S. aureus* infection through SKN-1-related pathway(s). The p38 MAPK and/or IIS pathway might be involved in the phenomenon, because *skn-1*/Nrf is a transcription factor regulated by those pathways. We are currently conducting mutant analyses to verify their involvement in the *B. subtilis* (natto)-induced host resistance.

Keyword: Bacillus subtilis var. natto, Staphylococcus aureus, defense response, C. elegans

PAB(T7-108)
Cholesterol lowering and anti-obesity effects by the combination of heat-treated lactobacillus KDP and guar gum in mice fed a high-fat diet

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Objectives: KDP, heat-treated *Lactobacillus sakei* is expected to function as paraprobiotics. Guar gum, a soluble fiber obtained from guar bean, has prebiotic properties. We found that the combination of paraprobiotics and prebiotics synergistically alleviated obesity and cholesterol levels, but the mechanism is unknown. Therefore, we conducted experiments to elucidate the mechanism by which the ingestion of heat-treated KDP alone and the combined ingestion of KDP and guar gum lowers cholesterol in high-fat diet-induced obese mice.

Methods: Six-week-old male C57BL/6J mice were divided into 5 groups: standard diet (ST), high-fat diet (HF), 5% guar gum + high-fat diet (Guar), 0.1% KDP + high-fat diet (KDP), and 5% guar gum + 0.1% KDP + high-fat diet (Mix) for 16 weeks. Water and feed were consumed ad libitum. At 16 weeks of rearing, the mices were dissected, and their organs were harvested for analysis. Gene expression analysis related to lipid metabolism in adipose tissue and cholesterol metabolism in liver were conducted. **Results:** Perirenal adipose tissue showed a significant decrease in the Mix group compared to the HF group. Lipid metabolism-related gene (*PPARγ, GPR43, Fasn, Acaca*) expression tended to increase in *PPARγ* and G*PR43* in the Mix group. Mix diet may improve of lipid metabolism. Furthermore, total cholesterol levels were significantly lower in the Mix group than in the HF group. Expression analysis of cholesterol metabolism-related genes (*ABCG5, ABCG8, BSEP, ABCC2, HMGCR, Cyp7α1,* and *LDLr*) in the liver was conducted. *Cyp7α1, HMGCR*, and *LDLr* expressions were decreased in the Mix group compared to HF group. This result suggests that cholesterol lowing effect of Mix may be involved in the inhibition of cholesterol synthesis.

Conclusion: Combined consumption of heat-treated KDP and guar gum significantly reduced perirenal adipose tissue weight and total cholesterol levels in high-fat diet-induced obese mice by improving lipid metabolism and inhibition of cholesterol synthesis.

Keyword: dietary fiber, Lactobacillus sakei, guar gum, cholesterol, obesity

Conflict of Interest Disclosure: This study is funded by Daiwa Pharmaceutical Co., Ltd. Naoki Igari is an employee of Daiwa Pharmaceutical Co., Ltd. Xia Zhu is an employee of Daiwa Pharmaceutical Co., Ltd.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-109)
Novel mung bean-derived peptides improve glucose metabolism by activating AMPK in diabetic KK-A^{y} mice

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Background and objectives: Mung bean (*Vigna radiata* L.), a common food consumed particularly in Asia, is well-known for its nutritive values as well as for its roles in Chinese medicine. Mung bean protein, which can be produced at an industrial scale, is emerging as a candidate for new plant-based protein. In this study, we found that the enzymatic digest of mung bean protein exhibited glucose-lowering effect. We then investigated mung bean specifically derived peptides that could decrease blood glucose and the potential mechanisms.

Methods: Male healthy mice (ddY or C57BL/6N) treated with high-fat diet (HFD), and KK-A^{y} mice, a type II diabetic model, were used. To investigate the effects on glucose metabolism, the oral glucose tolerance test (OGTT) and the intraperitoneal insulin tolerance test (IPITT) were performed after intraperitoneal administration of samples. The peptides were chemosynthesised by F-moc strategy. AMPK phosphorylation in tissues from KK-A^{y} mice was measured by Wes, a capillary electrophoresis western analysis.

Results: The mung bean protein digest significantly lowered blood glucose levels in HFD-fed mice after glucose administration; however, the digest did not increase insulin sensitivity in IPITT. These results suggest that the digest could enhance glucose tolerance and therefore improve glucose metabolism in HFD-fed mice independent of insulin action. The candidate bioactive peptides were chosen based on the homology of mung bean protein with the LC-MS comprehensive peptide analysis of soy protein digest [1], together with the structure-activity relationship. Among candidate peptides, we found two peptides, LLLPHY and LAGEK, enhanced glucose tolerance in OGTT in HFD-fed mice. Moreover, the glucose intolerance of diabetic KK-A^{y} mice was significantly improved by both peptides. AMPK activation is well-known for insulin-independent modulation of glucose metabolism. Indeed, we found that both peptides significantly increased hepatic AMPK phosphorylation. Lastly, we investigated the enzymatic conditions to produce these peptides, and their presence in the digests was confirmed by LC-MS.

Conclusions: This study newly discovered peptides derived from mung bean protein that can improve glucose metabolism *in vivo* for the first time by activating AMPK.

Keyword: Mung bean protein, Anti-diabetic peptides, AMPK, KK-Ay, Plant-based food

[1] *Mori et al.* FASEB J 2018; 32 (2):568-575

PAB(T7-110)
The dietary isoflavone daidzein regulates the expression of pro-inflammatory and antioxidative genes in hepatocyte and macrophage co-culture

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Background and objectives: Nonalcoholic fatty liver disease(NAFLD)is a disease in which there is significant lipid accumulation in the liver in the absence of excessive alcohol intake. Three major factors are thought to be involved in the progression of NAFLD: lipid accumulation, oxidative stress, and inflammation. Daidzein, a soy isoflavone, has been reported to exert protective effects on hepatic steatosis in animal models, however the exact mechanisms remain unclear. Therefore, we investigated the effects of daidzein on hepatocyte lipid accumulation, and on inflammation and oxidative stress caused by hepatocyte-macrophage crosstalk.

Methods: Mouse hepatocyte cell line Hepa1-6 and mouse macrophage cell line RAW264 were used. To evaluate the effect of daidzein on lipid accumulation, Hepa1-6 were treated with abmixture of palmitic acid (PA) and oleic acid (OA) with or without 50 μM daidzein, and the lipid content was assessed by Oil red O staining. To investigate the effect of daidzein on inflammation and oxidative stress, Hepa1-6 and RAW264, were co-cultured in same dishes and incubated with daidzein. Gene expression levels of inflammatory mediators and antioxidant enzymes were evaluated by RT-PCR and the protein expression levels of upstream signaling molecules were examined by Western blotting.

Results: In Hepa1-6 cells, daidzein had no effect on the intracellular lipid accumulation induced by addition of PA and OA mixture. In co-cultured cells, daidzein treatment significantly suppressed gene expression levels of inflammatory mediators, Inducible nitric oxide synthase (iNOS) and Interleukin-1 beta(IL-1ß), which were increased by co-culture itself. As a mechanism, the nuclear translocation of NFkB was suppressed by daidzein. In addition, daidzein treatment significantly increased the gene expression of the antioxidant enzymes Heme oxygenase 1 (HO-1), NADPH quinone oxidoreductase 1 (NQO1), and Superoxide dismutase (SOD). It is known that the transcription of these genes are promoted by activating Akt, which cause nuclear translocation of Nrf2. In co-cultured cells, daidzein significantly increased Akt activation and nuclear Nrf2 content.

Conclusions: These findings suggest that daidzein may prevent the progression of NAFLD by inhibiting inflammation via the NFkB pathway and enhancing antioxidant properties via the Akt/Nrf2 pathway.

Keyword: daidzein, hepatocyte, macrophage, inflammation, antioxidant

Conflict of Interest Disclosure: Nothing

Further Collaborators: Nothing

PAB(T7-111)
Effects of selective fish oil consumption at end of the day on high-fat diet-induced overweight in mice

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Background and objects: Animals, including rodents and humans, tend to preferentially select fatty foods for their good flavor and texture. However, it was unclear whether these preferences observed in the presence of plural fat-based diets indicates diurnal differences, and then affects weight gain. Therefore, we investigated the effects of selecting high-fat diets composed of soybean oil, lard, and fish oil on metabolic parameters in mice using a self-selection regimen from two diet boxes.

Methods: Four-week-old male C57BL/6 mice were given two diet boxes per cage: two 30% (w/w) soybean oil-based high-fat (SOY) diet boxes (w-SOY), a SOY-diet box and a 30% (w/w) lard-based high-fat (LARD) diet box (SOY-vs-LARD), and a SOY-diet box and a 30% (w/w) fish oil-based high-fat (FISH) diet box (SOY-vs-FISH). The mice were permitted free access to deionized water and both diet boxes. Diurnal food intake patterns were analyzed, and the individual diet boxes were weighed every 2 hours for 48 hours at week 7. After 8 weeks consumption, the blood biochemical parameters and fatty acid composition were analyzed.

Results: Mice preferred the LARD diet over the SOY diet and the SOY diet over the FISH diet, although the total energy intake was the same for all three groups. These preferences are likely due to the different fatty acid compositions, especially the omega-6/omega-3 ratio. The SOY-vs-LARD group gained significantly more weight than did the w-SOY and SOY-vs-FISH groups, indicating that daily selective consumption of high omega-6/omega-3 ratios from fat (lard) induces excess weight gain. Additionally, minimal but selective consumption of an omega-3 fatty-acid-rich FISH diet at the end of the active period increased the physiological fatty acid compositions of eicosapentaenoic acid and docosahexaenoic acid in the SOY-vs-FISH group, and their metabolic parameters were lower than the w-SOY group.

Conclusions: The results obtained in this study imply that consuming small amounts of fish oil at the end of the active period may help prevent excess weight. We are currently conducting the study on the effects of the mixing oils.

Keyword: Selectivity, High fat diet, Fatty acid composition, Overweight, Mice

PAB(T7-112)
Effect of supplemented flaxseed oil with tocopherols and phytosterols on the mechanisms involved in the prevention of liver steatosis

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Background and objective: High fat (HF) intake has been associated with liver steatosis in humans and experimental animals, and we had demonstrated that flaxseed oil (FO) rich in α-linolenic acid (ALA) supplemented with a purified extract of oil deodorizer distillate (DD) rich in tocopherols and phytosterols attenuated the liver damage and triacylglycerol (TAG) accumulation. The aim of this preliminary study was to investigate some mechanisms involved on the liver steatosis attenuation by a FO supplemented or not with DD.

Methods: Male *Wistar* rats were fed (60-d) recommended (SO7: soybean oil-SO-, 7%) or HF (30%) diets containing SO or FO supplemented or not with 1% of DD (SO30, FO30, SO30DD and FO30DD diets, respectively). Liver TAG levels, fatty acids (FA) profile, *in vivo* VLDL-TAG secretion rate (TAG-SR), and mRNA levels of key lipogenic and oxidative enzymes and transcription factors, as well as, transport proteins.

Results: Among the most important changes, FO30 diet (vs SO30) reduced the hepatic TAG (-65%) levels, associated with an increased ALA, EPA and DHA incorporation, without significant differences in the hepatic TAG-SR and mRNA levels of β-oxidative genes. Notoriously, the supplementation with 1% of DD (FO30DD diet), resulted in a similar reduction of hepatic TAG levels (- % vs SO30) and incorporation of FA that those founded in FO30 diet, but increased (+500%) the mRNA levels of PPARα and CPT1a and reduced the mRNA levels of FATP2 and FATP5 (vs SO30 and FO30 diets).

Conclusions: The prevention of liver steatosis induced at high fat levels by flaxseed oil supplemented with a tocopherols and phytoesterols mixture could be related to an enhanced β-oxidation pathway and a reduction of the fatty acid uptake by the hepatocytes. Nonetheless, further studies are required to explain the mechanism involved in the beneficial effects of FO30 alone on liver steatosis. Flaxseed oil supplemented with tocopherols and phytosterols might play an important role as bioactive compounds preventing non-communicable chronic diseases like liver steatosis in humans.

Keyword: Flaxseed oil, Liver steatosis, Tocopherols, Phytosterols, High fat diet

Conflict of Interest Disclosure: There are not conflict of interest to declare

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-113)

Comparative Analysis of Differently Originated Blackcurrant(*Ribes nigrum*) Powder on the Antioxidant Activity and Phenolic Contents.

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Background and Objectives: Berries are known to have antioxidant effect of anthocyanins, phenols, and flavonoids from previous studies. Blackcurrant(*Ribes nigrum*), in particular, is known as one of the phytochemical-rich berries with high antioxidative effect. The aim of this study is to compare the antioxidant capacity and the contents of anthocyanin, phenol, and flavonoid in Blackcurrant powders from different origins, such as South Korea(KOR), Poland(POL), America(USA), present on the market.

Methods: The lyophilized Blackcurrant powders which were cultivated in POL, USA, and KOR was extracted by 50% EtOH(50mg/ml) under the same conditions. The antioxidant and free radical scavenging activities were investigated using DPPH and ABTS radical scavenging capacity assay, and total phenolic, flavonoid, and anthocyanin contents were determined by each of its own method using Blackcurrant ethanolic extracts.

Results: The result of ABTS assay was significantly higher in POL($p<0.01$), while DPPH assay was significantly higher in KOR($p<0.005$) than the other two. The highest amounts of anthocyanin, phenol, and flavonoid were all found in POL among 3 samples; The anthocyanin ($p<0.005$) and flavonoid ($p<0.005$) contents were significantly higher than other two, while phenolic content($p<0.005$) was only significantly higher than USA.

Conclusions: The Blackcurrant powder from POL may have the potential of highest antioxidant capacity and phytochemical contents among three of the powders used in this study. The further study in vivo mouse model of non-alcoholic fatty disease(NAFLD) is in progress to prove that antioxidant capacity of the phenolic contents of Blackcurrant powder can ameliorate ceremide synthesis in liver.

Keyword: Blackcurrant, Antioxidant, Anthocyanin, Phenol, Flavonoid

Conflict of Interest Disclosure: Funded by Korea Disease Control and Prevention Agency

Further Collaborators: Non

PAB(T7-114)

Evidence on a brain transport of anti-cognitive dipeptide, Tyr-Pro, after oral administration to mice

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Background and objectives: Transportation of substances to the brain is strictly regulated by the blood-brain barrier (BBB). A dipeptide, Tyr-Pro (YP), capable of crossing the BBB in intact form [1] and improving impaired memory in amyloid β-injected Alzheimer's disease model mice [2], has a potential for cognitive prevention. However, no study has been reported on intact accumulation of the dipeptide into brain after oral intake. In the present study, we thus tried to clarify the bioavailability of YP, including brain transport, after the intake to mice.

Methods: A single oral administration of stable isotope-labeled YP ([$^{13}C_5$, ^{15}N] YP) was performed in male ICR mice and taken blood and brain at 0–2 h after the administration. Perfusion of cerebral vessels by physiological buffer was performed prior to the collection of brain. The amount of YP in plasma and brain were determined by an LC-qTOF/MS, in combination to a 3-aminopyridyl-N-hydroxysuccinimidyl carbamate (APDS) derivatization technique (405.1800 m/z > 285.1467 m/z<).

Results: A highly sensitive detection of isotope-labeled YP at > fmol/injection level was achieved by the APDS-aided LC-qTOF/MS analysis. The APDS-LC-qTOF/MS analysis on the plasma revealed that YP dosed at 10 mg/kg entered the blood in its intact form (T_{max}: 15 min, $T_{1/2}$: 9.82 min, C_{max}: 1.04 nmol/mL). In the brain we successfully detected the isotope-labeled YP at ~200 fmol/mg of whole brain at 15 min after the oral administration.

Conclusions: The present study provided the first finding that a dietary YP is an absorbable bioactive compound into the circulating bloodstream, and rapidly (15 min after the intake) reaches to the mouse brain parenchyma in intact form or without degradation.

Keyword: Dipeptide, blood-brain barrier, bioavailability, LC-qTOF/MS, cognitive improvement

[1] Tanaka, M. et al. Sci Rep 9, 5769 (2019). [2] Tanaka, M. et al. npj Sci Food 4, 7 (2020)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-115)
AMPK negatively regulates RANKL-induced osteoclast differentiation by suppressing oxidative stress

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Background and objectives: AMP-activated protein kinase (AMPK) is a crucial energy sensor of cellular metabolism in response to various metabolic stresses such as oxidative stress and inflammation. AMPK has been shown to stimulate the differentiation and proliferation of osteoblasts, but its role in osteoclasts remains unclear. Thus, this study determined the mechanistic connection between AMPK and osteoclast differentiation, and the potential role of AMPK in the anti-resorptive effects of several phytochemicals.

Methods: The murine macrophage RAW 264.7 cells were transfected with AMPK siRNA and treated with 50 ng/mL receptor activator of nuclear factor-kappa B ligand (RANKL). Tartrate-resistant acid phosphatase (TRAP)-positive multinucleated cells were counted by TRAP staining. We measured osteoclast-specific gene and protein expression by real-time PCR and western blotting. Moreover, involvements of signaling pathways such as mitogen-activated protein kinase (MAPK), nuclear factor-kappa B (NF-κB), and reactive oxygen species (ROS) in the effect of AMPK were analyzed.

Results: RANKL-induced osteoclast differentiation, osteoclastic gene expression, and activation of p38 MAPK, JNK, and NF-κB were promoted in cells transfected with AMPK siRNA. Knockdown of AMPK led to defective synthesis of heme oxygenase-1 (HO-1), an antioxidant enzyme involved in the suppression of oxidative stress. Furthermore, treatment with N-acetyl-L-cysteine (NAC) abolished osteoclast differentiation and MAPK/NF-κB pathways induced by AMPK knockdown. The AMPK activators, hesperetin, gallic acid, resveratrol, and curcumin, also suppressed osteoclast differentiation via the activation of AMPK.

Conclusions: Our data suggest that AMPK could effectively inhibit RANKL-induced osteoclast differentiation by suppressing oxidative stress. AMPK activation by dietary-derived phytochemicals may be a therapeutic strategy for reducing the risk of bone diseases.

Keyword: AMPK, osteoclast, oxidative stress, polyphenol

PAB(T7-116)
Difference of oleic acid effects on muscle fiber type in differentiated myotubes and isolated mature muscle fibers of mice

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Background and objectives: Skeletal muscle is important tissue which regulates the metabolism and locomotive ability. Bundles of numerous muscle fibers build the muscle tissue, however different kinds of muscle cells, such as satellite cell, myoblast, myotube, and muscle fiber, are present depending on the process of muscle formation. Myotubes are often used as representative in vitro models of muscle however we have reported the difference of contractile properties between myotubes and mature muscle fibers isolated from muscle tissue. In addition, there are two major classification of muscle fiber types, type 1 (slow-twitch oxidative) and type 2 fibers (fast-twitch glycolytic), according to contractile and metabolic properties. The muscle fiber type is regulated by exercising, however we revealed that dietary olive oil intake improves runnning endurance and muscle metabolism in mice. The present study was aimed to investigate the effects of oleic acid, abundant in olive oil, on muscle fiber type in differentiated myotubes and isolated mature muscle fibers in vitro.

Methods: C2C12 myoblast were differentiated in 2% HS-DMEM for 72 hours to form myotubes. The flexor digitorum brevis muscle of C57BL/6J male mice was harvested and incubated in 0.2% collagenase solution. The tisuue was triturated to single fibers and isolated fibers were cultured in 30% FBS-DMEM. 100 μM oleic acid was supplemented in culture medium of each cell. After 6-hour, total RNA was extracted and the mRNA expression was analyzed by real-time RT-qPCR.

Results: We found that the transcript levels of Myh7, Pdk4, Cpt1b, Angptl4, Cd36, and Ppargc1a were significantly upregulated in myotubes of oleic acid supplementation. In isolated muscle fibers, the transcript levels of Pdk4, Cpt1b, Angptl4, and Cd36 were significantly upregulated in oleic acid supplementation, however the expression of Myh7 and Ppargc1a did not change.

Conclusions: The central finding of this study was that oleic acid supplementation increased transcript levels of key genes related oxidative metabolism in both myotubes and isolated muscle fibers, however type 1 fiber marker (Myh7) was regulated only in myotubes. Our results indicate that oleic acids are more likely to affect to muscle fiber types in newly formed myotubes rather than mature muscle fibers.

Keyword: Skeletal muscle, fiber type, oleic acid, myotube, isolated muscle fiber

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-117)
Effects of Itadori (Fallopia Japonica) leaf extract using ethanol on colorectal cancer cells

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Background and objectives: Malignant neoplasms are the leading cause of death in Japan, with colorectal cancer accounting for the second highest mortality rate in the country. Recently, many polyphenols have been reported to have anticancer-like effects on colorectal cancer cells, and the prevention of cancer through the consumption of specific foods has been gaining attention. The stems of Itadori (Fallopia japonica) are consumed in Kochi Prefecture, and the leaves of the plant are rich in polyphenols (quercetin, rutin, neochlorogenic acid, and piceatannol). Therefore, in this study, effects of polyphenols contained in Itadori leaf extract were investigated on an established cell line derived from mouse colorectal cancer cells.

Methods: Mouse colorectal cancer cells, Colon-26, was used in the experiments. The medium used was RPMI 1640. The component extracted from dried Japanese knotweed leaves by using 80% ethanol was lyophilized and used. The extract was added to the medium and incubated at 37℃ in the presence of 5% Carbon Dioxide. Cell viability was then determined using the WST-8 method and the trypan blue dye exclusion test. Apoptosis was confirmed using the DNA ladder and caspase assays. The polyphenols quercetin, rutin, neochlorogenic acid, and piceatannol were added to the cells, and similar measurements were performed.

Results and Discussion: The addition of Itadori leaf extract at a concentration of 1 mg/mL or higher caused a significant decrease in cell viability in the WST-8 method. The DNA ladder assay showed DNA fragments at 250, 500, and 1000 μg/mL for piceatannol, and at 250 and 500 μg/mL for the other polyphenols. In the caspase assay, the addition of the Japanese knotweed extract, neochlorogenic acid, rutin, and quercetin significantly increased activity.

Conclusions: Itadori leaf extract had an apoptosis-inducing effect through its constituent polyphenols on an established cell line derived from mouse colorectal cancer cells.

Keyword: Skeletal muscle, fiber type, oleic acid, myotube, isolated muscle fiber

PAB(T7-118)
Changes in response and saliva-related gene expression into amino acid stimulation in cell line A253.

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Background and objectives: More than half of people over 65 years old sometimes feel dry mouth. Decreased saliva secretion is thought to be one of the causes of food intake reduction, malnutrition and decline in their QOL. Increased salivation by salivary gland stimulation have the potential to improve QOL. Cell line A253 from human salivary gland tumor was used to attempted to find metrics for salivary gland stimulation. We previously reported that the A253 expressed all 25 isoforms of hTAS2R, hT1R3 and alpha-Amylase, and also responded to some bitter compounds. The amino acids in foods have various tastes for example, bitterness and sweetness. In this study, we examined the responsiveness to amino acids and the expression of saliva-related genes using the A253.

Methods: $5x10^4$ cells/well of A253 strain were incubated in McCoy's 5A medium containing 10% FBS, 5% CO_2 for 24 hours at 37ºC. Stimulation of A253 with each of 20 amino acids was performed at concentrations up to 10 times the threshold, based on the threshold. Then, intracellular calcium concentration was measured by calcium imaging using Fluo-8. The expression levels of saliva-related genes stimulated with alanine, arginine, lysine, phenylalanine were measured by qRT-PCR.

Results: Among 20 amino acids, A253 responded to 14 amino acids; those are arginine, histidine, leucine, methionine, phenylalanine, isoleucine, tryptophan, alanine, glycine, proline, lysine, valine, glycine and cysteine. The expression level of AMYLA was changed by the stimulation with alanine, arginine, lysine and phenylalanine. Similarly, expression level of MUC7 was changed by the stimulation with alanine, arginine and lysine and ANO1 was changed with only alanine and arginine.

Conclusions: From above results, it was speculated that the expression of saliva-related genes in the A253 was dependent on the taste components, to which the cells responded. It is speculated that changes in the expression of these genes may be indicators of salivary gland stimulation. Clinical trials will need to be conducted to investigate the effects of taste substances on saliva production hereafter. This research was supported by a Grant-in-Aid from the Showa Women's University.

Keyword: salivary glands, stimulation, amino acid, cell line, model

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-119)
Dipeptide FP(Phe-Pro) improves cholesterol metabolism via PepT1 and appears in portal blood.

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Background and objectives: There have been no reports on *in vivo* active cholesterol-lowering dipeptide in any protein origin. We discovered a novel cholesterol metabolism-improving peptide FP (phenylalanine-proline) from 400 dipeptides for the first time in the world (1). In this study, we evaluated the cholesterol-lowering effects *in vivo* and *in vitro*, including in *PepT1* KO mice. In addition, we administered a single oral dose of FP to rats and quantified its concentration in portal plasma, using LC-TOF/MS analysis.

Method: The effect of FP on the cholesterol absorption system was analyzed in Caco-2 cells. Wistar male rats were fed on a high-fat, high-cholesterol diet and orally administered FP for 14 days to evaluate its effects on lipid metabolism. Wild-type C57BL/6J male mice and *PepT1* KO mice were fed on a high-fat, high-cholesterol diet and orally administered FP for 14 days to evaluate its effect on lipid metabolism. FP (600 mg/kg B.W.) was administered orally as a single dose to male Wistar rats, and portal blood sampling was performed before and after administration (15, 30, 60, and 120 min). The obtained plasma was subjected to LC-TOF/MS analysis, using the stable isotope FP ($[^{13}C_9, ^{15}N]$Phe-Pro) and the inducing reagent AccQ Tag.

Results: Cholesterol absorption was significantly reduced by FP in Caco-2 cells. FP induced a significant decrease in lipid metabolism-related mRNA levels. Serum total cholesterol of rats was significantly decreased and HDL-cholesterol was significantly increased. The jejunal ABCA1 mRNA level was also significantly decreased. In wild-type mice, cholesterol absorption, serum total cholesterol, liver cholesterol, and liver lipids were significantly decreased. From LC-TOF/MS analysis, the FP concentration detected in portal plasma was 0.485 nmol/ml at 30 minutes after administration.

Conclusions: In this study, we found that the cholesterol metabolism-improving effect of dipeptide FP is mediated by PepT1. Furthermore, 0.485 nmol/ml of FP was detected in rat portal vein plasma.

Keyword: Dipeptide, PepT1, ABCA1, Cholesterol, LC-TOF/MS

(1) Banno, A. *et al. Sci. Rep*. 9, 19416 (2019).

PAB(T7-120)
In vitro and *in vivo* inhibitory effects of Japanese black tea on postprandial blood glucose elevation

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Background and Objectives: Correcting postprandial hyperglycemia has been shown to be clinically effective in preventing the development and progression of insulin resistance and type 2 diabetes. Many approaches have been used to suppress absorption of carbohydrates by inhibiting digestive enzymes, such as α-amylase and α-glucosidase, to mitigate the elevation of postprandial blood glucose levels. We evaluated the α-glucosidase inhibitory activity of Japanese black teas *in vitro* and investigated their inhibitory effects on postprandial blood glucose elevation in human subjects.

Methods: α-glucosidase inhibitory activity of 11 species, 20 kinds of Japanese black tea were compared. *In vivo* study was randomized, placebo-controlled, crossover study. Thirty-two eligible subjects took Japanese black tea or water as a placebo with white rice as a test meal. Blood glucose was measured at 0, 30, 60, 90, 120 min after the meal, and we compared the changes between Japanese black tea group and placebo group.

Results: α-glucosidase inhibitory activity of Japanese black tea differed among different species and harvest area. There was correlation with the α-glucosidase inhibitory activity of Japanese black tea and the total polyphenol content. Even for the same species of leaves, the α-glucosidase inhibitory activity of black tea was higher than that of green tea. Japanese black tea suppressed the increase of blood glucose at 30 min after the meal, and the effect was especially marked in subjects whose postprandial blood glucose levels were higher at this time point.

Conclusions: These results suggest that intake of Japanese black tea reduced carbohydrate metabolism in the gastrointestinal tract, showing a lower postprandial blood glucose level in human subjects. Consequently, ingestion of Japanese black tea might be useful for preventing the development and progression of insulin resistance and type 2 diabetes.

Keyword: Japanese black tea, α-glucosidase inhibitory activity, postprandial blood glucose elevation, human subjects

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-121)

The effect of Spirulina compounds on insulin sensitivity and renal function in patients with chronic kidney disease: a randomized double-blind placebo-controlled study

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Background/Objectives: Chronic Kidney disease (CKD) is considered a global public health problem, that causes high risk of mortality in cardiovascular diseases CVDs, and insulin resistance (IR) and uncontrolled hypertension is an early metabolic alteration in CKD patients. Spirulina is microalgae with nutritious ingredients and has potential effects on enhanced cardiovascular and metabolic health. Therefore, the aim of the present study was to investigate the effects of spirulina compounds on metabolic parameters in CKD patients.

Methods: In a double-blind, placebo-controlled clinical trial. we recruited 50 subjects with early CKD (CKD stages 2-3) in the outpatient clinic of China Medical University Hospital in Taiwan, Subjects were randomly assigned to four groups [group A: placebo (*n* = 10), group B*: Spirulina* 250 mg (*n*= 12), group C: *Spirulina* 500 mg + glutathione 200mg + vitamin C 200mg (*n* = 14), group D: *Spirulina* 500mg (*n* = 14)] and each randomized to receive 4 capsules of Spirulina or placebo daily for 12 weeks. The hematological parameters, anthropogenic indices were measured/ assessed at the 0 and 12th week.

Results: At baseline, there were no significant differences in a outcome variables among four groups. Insulin (16.9 ± 14.5 vs 12.2 ± 11.4 μIU/mL), HOMA-IR (4.4 ± 3.6 vs 3.3 ± 2.9) and triglyceride (178.3 ± 96.5 vs 133.9 ± 55.1 mg/dL) at baseline and week 12 in patients receiving group C supplementation. After 12 weeks, systolic blood pressure in patients receiving group B supplementation was significantly lower that of 6.6%. However, there was *no significant improvement* in renal *function among groups* (*P*>0.05) after intervention.

Conclusion: A Spirulina complex supplementation improved insulin resistance in patients with CKD stage 2-3 after the 12 week follow-up period.

Keyword: Spirulina, Chronic kidney disease, Insulin resistance, Renal function

PAB(T7-122)

Functional food ingredients reduce lung metastasis by using B16-BL6 melanoma cells

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Background and objectives: Some functional food ingredients have an inhibitory effect on angiogenesis, which was suggested to be related to cancer. We focused on the preventive effect on the metastases of lung cancer through functional food ingredients with an inhibitory effect of angiogenesis. In this study, we aimed to analyze the effect of some functional foods in a mouse model of murine melanoma employing the B16-Bl6 melanoma cell lines and C57BL/6 mice.

Methods: In the lung cancer metastasis model, B16-BL6 cells were intravenously injected into C57BL/6 mice. Functional food ingredients were fed to mice. The role of functional food ingredients, such as carnosic acid, pisiferic acid, oleoylethanolamide, and Japanese *Sake* cake, were examined. We conducted some behavioral experiments for brain function. The number of lung metastases and lung weights were measured at the end of the experiments. To further clarify the mechanism, integrin expression on B16-BL6 cells was examined by flow cytometry and cell adhesion assay. Cell adhesion analysis was performed using various integrin ligands coated plates.

Results: We found that ingestion of some functional food ingredients was suppressed in the metastasis of lung cancer. In the light/dark box test, the carnosic acid group showed an anxiolytic effect. Flow cytometry analysis revealed that carnosic acid and pisiferic acid suppressed α4 integrin expression on B16-BL6 cells. Furthermore, carnosic acid treatment led to the inhibitory effect for α4, α9, and RGD recognizing integrin-dependent cell adhesion.

Conclusions: Our study demonstrated the preventive effects of functional food ingredients on lung cancer metastasis via suppression of integrin expression.

Keyword: lung metastasis, B16-BL6 cells, integrin, carnosic acid

PAB(T7-123)

Effect of starch-degraded rice endosperm protein on obesity in mice fed a high fat and sucrose diet

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Background and objectives: Rice is not only an energy source, but also an important protein source for Asian people. Some studies on the physiological functions of rice endosperm

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

protein (REP) have been reported. There are two types of REP isolates reported: the one prepared by an alkali-extraction method (AE-REP) and the other prepared by a starch-degradation method (SD-REP). Most of the studies about the physiological functions have been conducted using AE-REP. Obesity is a risk factor for many diseases such as diabetes and many studies about anti-obesity have been conducted using various food materials. There is no reports of SD-REP about obesity although it was reported that AE-REP had suppressive effects on obesity . Therefore, we clarified whether SD-REP, which was characterized by less digestibility of prolamin, had anti-obesity effects or not.

Methods: Six-week-old male C57BL/6 mice were divided into three groups, mice fed a high fat and sucrose casein diet (HC), a high fat and sucrose SD-REP diet (HR), and a normal casein diet (NC). Mice were fed each experimental diet for 10 weeks and the body weight (once a week) and the feed intake (every day) were measured. Feces were collected for 4 days before the end of the experiment and subjected to the fecal lipid excretion analysis. At the end of the experiment, the blood samples were withdrawn from the inferior vena cava and the viscera (liver, kidney, perirenal fat, epididymal fat, and mesenteric fat) were collected. The collected blood samples were subjected to the biochemical analysis.

Results and conclusions: The body weight in the HR group was significantly suppressed after 2 week, compared with one in the HC group. The perirenal, epididymal, and mesenteric fat weights were also significantly lower in the HR group. These results strongly suggests that SD-REP has suppressive effects on obesity. In addition, aspartate aminotransferase and alanine aminotransferase in the blood, which are typical liver dysfunction markers, were significantly lower in the HR group, inferring that SD-REP has protective effects on liver functions. Therefore, SD-REP may have the suppressive effects on obesity and liver dysfunctions.

Keyword: rice endosperm protein, starch-degraded rice endosperm protein, obesity, aspartate aminotransferase, alanine aminotransferase

PAB(T7-124)
Arctigenin-containing food materials prevent obesity by improving composition of gut microbiota in obese mice

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Background and objectives: Gut microbiota affect the health status of the host, with dysregulation in the gut environment being linked to various disorders. For example, the Firmicutes/Bacteroidetes (F/B) ratio and the amount of *Akkermansia muciniphila* in the microbiota have been closely linked to obesity. In this study, we evaluated the effects of an anti-obesity lignan compound, arctigenin (AG), and AG-containing food materials, on the gut microbiota in an obese mouse model.

Methods: C57BL/6J mice were fed a high-fat high-sucrose (HFHS) diet with AG, burdock sprout extracts (GSE), forsythia leaf extracts (RLE), and metformin (MF) for 8 weeks. The composition of gut microbiota and cecal content of short-chain fatty acids (SCFAs) were determined using 16S rRNA gene sequencing and high performance liquid chromatography, respectively. The qPCR was performed on the fecal samples used for 16S rRNA gene sequencing to determine the abundance of *A. muciniphila.*

Results: Body-weight gain was significantly suppressed in obese mice treated with AG, GSE, RLE, and MF compared with that in the HFHS group. Analysis of the gut microbiota revealed that the F/B ratio was significantly reduced in the AG-, GSE-, and RLE-treated groups in comparison with HFHS group. Furthermore, the copy number of *A. muciniphila* in the feces was significantly increased in obese mice treated with AG, GSE and RLE. In particular, the increase in *A. muciniphila* in the RLE group was remarkable compared to that in the AG and GSE groups. In addition, the amount of SCFAs in cecal content was significantly increased following AG, GSE, and RLE treatment.

Conclusions: Collectively, these results suggest that AG, AG-containing GSE, and RLE prevent obesity by inducing changes in the gut microbiota. The positive effect observed in the GSE group is considered to be exerted by the AG. In contrast, the effect of RLE may be related not only to AG but also to other polyphenols and dietary fiber. Therefore, AG should be further evaluated as a novel prebiotic for reducing obesity, as well as improving intestinal health. GSE and RLE are potentially useful raw food materials for AG consumption.

Keyword: Arctigenin, Obesity, Gut microbiota, Burdock sprout extracts, Forsythia leaf extracts

PAB(T7-125)
Palmitic acids suppress gene expression of myosin heavy chain via MyoD inactivation

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Background and objectives: Sarcopenia is defined as the loss of skeletal muscle mass and strength, and known to cause physical disability, reduced quality of life and death. Aging and poor nutrition are known causes of sarcopenia, but recently fat accumulation due to obesity has also been considered as a cause. In particular, palmitic acids (PA) secreted from hypertrophied adipocytes is reported to induce myotube atrophy, however the underlying mechanism is still unclear. In this study, we therefore investigated the effect of PA on myoblast differentiation and myofiber maturation, which plays an important role in maintaining muscle mass, and the mechanism underlying these effects.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: C2C12 mouse myoblast cell line derived from mouse muscle satellite cells was used. After the cells were differentiated into myotubes, the cells were exposed to PA and the mRNA levels of myogenic regulatory factors (MRFs) and myosin heavy chain (MHC) were examined by real-time PCR. To confirm the effects of PA on promoter activity of MHC2b gene, we performed luciferase reporter assays using the reporter plasmid containing MHC2b gene promoter and the MyoD expression plasmid. **Results:** Treatment with 0.4 mM PA for 24 hours inhibited morphological differentiation of C2C12 myoblasts and significantly decreased the mRNA expression levels of MyoD, myogenin, and certain types of MHC, particularly MHC2b. In promoter assays, forced expression of MyoD, a transcription factor involved in MHC2b expression, significantly increased MHC2b promoter activity, but this increase in activity was significantly reduced by PA. Inhibition of MyoD phosphorylation on serine residues attenuated the inhibitory effect of PA on MHC2b promoter activity. Furthermore, PA-induced decrease in gene expression of MHC2b was restored by treatment with myriocin, a ceramide synthetase specific inhibitor.

Conclusions: These results indicate that ceramide synthesized from PA induces phosphorylation of MyoD, which may suppress the activity of this factor, thereby reducing the promoter activity of MHC2b gene and suppressing its expression.

Keyword: skeletal muscles, palmitic acids, myosin heavy chain (MHC), MyoD, promoter activity

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PAB(T7-126)
Effect of imidazole-dipeptides deficiency on protein metabolism in skeletal muscle of exercise-loaded mice

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Background and objectives: Imidazole dipeptides (IDs) such as carnosine and anserine have been reported to have antioxidant, anti-fatigue, and cognitive function recovery effects as supplementation, but its endogenous physiological function in the body are not clear. In the present study, wild-type (WT) mice and KO mice (carnosine synthase-gene deficient knock-out mice) were used for exercise-loaded experiment, and we aimed to clarify the effect of IDs deficiency on protein metabolism in skeletal muscle of exercise-loaded mice.

Methods: 30-week-old male WT mice and KO mice (n = 4 in each group) were forcibly exercised for 2 weeks. After the loading, tissues were extracted under general anesthesia with isoflurane and these weights were measured. The gene expression levels of factors related to muscle protein metabolism in the gastrocnemius muscle were measured by quantitative RT-PCR. The free amino acid concentration in gastrocnemius muscle was measured. Protein hydrolysis method was followed to measure the total amount of protein in gastrocnemius muscle.

Results: There was no significant difference in the mileage in exercise by treadmill between the WT and KO groups, and also no significant difference in muscle weight. The amount of exercise load in this experiment did not affect the performance. The analyses of the gene expression levels of protein metabolism-related factors in muscle showed that the levels of gene expression in mTOR, Cathepsin L, atrogin-1, and PGC1α in the KO group were significantly lower than those in the WT group by 30%-50%. The amount of proteins in mice of WT group tended to be higher than that of the KO group. It was presumed that IDs deficiency suppressed the syntheses of skeletal muscle proteins in skeletal muscle during loaded exercise. In the next step, the effect of the administration of imidazole dipeptides on protein metabolism in skeletal muscle in mice after exercise loaded should be investigated.

Conclusions: IDs deficiency affected the protein metabolism in skeletal muscle, suggesting IDs may regulate the protein metabolism of skeletal muscle.

Keyword: Imidazole dipeptide, Carnosine synthase knockout mouse, Protein metabolism, Skeletal muscle , Exercise loaded

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PAB(T7-127)
Okra (*Abelmoschus esculentus* L.) as a potential source of functional food

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Background and objective: In recent years, many people have become health conscious, and hence, many research groups are investigating to find the functional food candidates, which have the possibility to protect our body from the life-related diseases, such as diabetes and obesity. Okra (*Abelmoschus esculentus* L.) is widely spread in the world, including Japan, and has attracted attention for its functional properties. Okra has a slimy consistency when chopping. This stickiness is attributed to pectin, a water-soluble dietary fiber. In this study, two kinds of okra, normal okra (NO) and pectin-rich okra (PRO), were used as test samples, and their biological functions were evaluated.

Methods: Corn and onion, which were used as control food materials, were freeze-dried, in addition of NO and PRO. Freeze-dried samples powders were washed by ethanol and dried to obtain pectin fraction. Their water-soluble pectin amounts were analyzed using carbazole-sulfate method. The antioxidant activity and total polyphenol amounts were analyzed using 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and Folin-Ciocalteu assay, respectively. Furthermore, antioxidative activity and polyphenol total content of pectin fractions from the PRO and NO were evaluated subsequently.

Results: The results showed that PRO indicated the significantly higher pectin amount than that of NO. PRO also

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

showed a significantly higher antioxidant activity and total polyphenol content compared to corn, onion, and NO. No significant differences were observed between pectin fractions from NO and PRO.

Conclusion: PRO has a significantly higher antioxidant activity, pectin, and total polyphenol amount compared to corn, onion, and NO. It could be possibly a potential source of functional food due to pectin amount and its antioxidant activity. Currently, we are conducting the study about the effects of pectin fraction from PRO on glucose absorption using *in vivo* assay system.

Keyword: Water-soluble pectin, Antioxidant activity , Total phenolic content, Okra

PAB(T7-128)
Effects of *Lactococcus* spp. on the lifespan and motility of *Caenorhabditis elegans*

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Background and objectives: In studies using the nematode *Caenorhabditis elegans* (*C. elegans*) as a surrogate model, various lactic acid bacteria have been reported to ameliorate the longevity and motility of the nematode. This study was performed to elucidate the effects of *Lactococcus* spp. on the longevity and motility of *C. elegans* as a host.

Methods: The wild-type *C. elegans* (N2) was employed as the experimental animal. Synchronized L1 larvae were grown at 25°C on nematode growth media (mNGM) with a standard diet, non-pathogenic *Escherichia coli* OP50 (OP), until 3 days old to be used for experiments. For survival study, the larvae were separated into a control group (fed OP) and a test group (fed *Lactococcu*s spp.) when they reached adulthood at 3 days of age. The Kaplan-Meier method was used to compute survival rates, and variations in survival rates were identified with the log-rank test. For this study, three distinct *Lactococcus* species (i.e. *Lactococcus formosensis, Lactococcus taiwanensis*, and *Lactococcus kimuchii*) were employed. Because of the nematode avoidance of *L. formosensis* and *L. taiwanensis*, they were fed a 1:1 mixture with OP.

Results: Nematodes fed alone with *L. formosensis* had significantly lower longevity and motility than the control group. Aside from that, nematodes fed only *L. taiwanensis* had a shorter lifespan but enhanced motility. Furthermore, nematodes fed with a mixture of *L. taiwanensis* and OP or *L. kimuchii* and OP exhibited no difference in longevity but increased their motility significantly.

Conclusions: We intend to investigate gene expression in *L. kimuchii*-fed worms in the future and investigate the mechanism of improved motility.

Keyword: Lactococcus spp., C. elegans, longevity, motility

PAB(T7-129)
Aesculetin blocks neutrophil elastase-mediated airway epithelial barrier disruption caused by inhalation of urban particulate matter

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Background and objectives: Particulate matter (PM), a mixture of solid and liquid air pollutant particles suspended in air, is the most harmful form of air pollution due to its ability to penetrate deep into the lungs and blood streams, causing diverse respiratory diseases. Neutrophil elastase (NE) is a major constituent of lung elastolytic activity and potently stimulates mucus secretion during airway inflammation. Aesculetin is a coumarin derivative that is known to have anti-inflammatory effects in the vascular and immune system. The current study investigated that naturally-occurring aesculetin attenuated NE-mediated urban PM10 (uPM10, particles less than 10 μm)-induced airway epithelial barrier dysfunction and tight junction disruption.

Methods: Mice were orally administrated with 10 mg/kg aesculetin and exposed to 6 μg/ml uPM10 for 8 weeks. To further explore the NE involvement in uPM10-induced epithelial junction disruption and inhibitory effects of aesculetin, bronchial epithelial BEAS-2B cells were treated with 1-20 µM aesculetin in the presence of 2 μg/ml uPM10 or 0.5 μg/ml NE.

Results: Oral administration of aesculetin attenuated NE accumulation and interleukin-1β secretion in the small airways inflamed by uPM10. Additionally, uPM10 markedly induced NE in bronchial epithelial BEAS-2B cells, which was dose-dependently inhibited by1-20 µM aesculetin. Expression of bronchial epithelial toll-like receptor 4 (TLR4) and epidermal growth factor receptor (EGFR) was highly enhanced within 2 h following treatment with 0.5 μg/ml NE. Interestingly, NE evoked a dual induction of EGFR at 24 h after exposure to NE. Such induction of both TLR4 and EGFR by NE was curtailed by treating 20 μM aesculetin to bronchial epithelial cells. It should be noted that uPM10 induced TLR4 and EGFR, which was hampered by aesculetin. Furthermore, aesculetin promoted the induction of epithelial tight junction markers including occludin-1 reduced by uPM10 and NE. The epithelial induction of TLR4 and EGFR was responsible for the disruption of bronchial tight junction. These results demonstrated that aesculetin blocked airway epithelial barrier disruption caused by uPM10 inhalation through inhibiting NE-stimulated TLR4 and EGFR.

Conclusions: Aesculetin may be a promising agent for restoring airway epithelial barrier integrity disrupted by urban coarse particulates.

Keyword: Aesculetin, urban particulate matter, neutrophil elastase, airway epithelial barrier integrity, airway epithelial tight junctions

Funding Sources: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2021R1A6A1A03044501).

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-130)
Effect of tomato seed extract and its major saponins on epidermal barrier functions and steroidal anti-inflammatory effect

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Background and objectives: Tomatoes *(Solanum lycopersicum)* are widely consumed around the world. As previous works regarding constituent study of tomato fruits, steroidal saponins have been isolated as lycoperosides and esculeosides. Among these saponins, orally administered esculeoside B isolated from tomato juice improved 2,4-dinitrochlorobenzene-induced type IV allergic dermatitis in mice. However, studies of tomato seeds on skin inflammation are limited. In this study, we have isolated 11 compounds, including solanocapsin type, spirosolan type, pregnan type, frostan type and spirostan type saponins and flavonoids from tomato seeds, to evaluated the effects on epidermal barrier functions and inflammation.

Methods: The screening for candidate compounds that improve epidermal barrier functions was assessed by measurement of mRNA expression of filaggrin, involucrin, serine palmitoyltransferase-2 (SPT2), ceramide synthase-3 (CerS3) and glucosylceramide synthase (GCS) on HaCaT cells. Epidermal barrier functions on the reconstructed human epidermal keratinization (RHEK) model were evaluated by measurements of transepidermal water loss (TEWL), ceramide contents in stratum corneum and mRNA expression of ceremide synthesis related enzymes including SPT2, CerS3, GCS, β-glucocerebrosidase (GBA), sphingomyelin synthase-2 and acid sphingomyelinase. On the other hand, the effect of lycoperoside H, the most abundant saponin in tomato seed, on atopic dermatitis (AD)-like symptoms was evaluated by oral administration to IL-33 transgenic (IL-33Tg) mice which is developed as AD model mice. In addition, binding ability to glucocorticoid receptor (GR) was evaluated by GR competitive assay.

Results: Among isolated compounds, all tomato seed saponins (10 µM) upregulated the mRNA expression of proteins related to epidermal hydration in HaCaT cells. These saponins (10 µM) except a pregnan saponin decreased TEWL in RHEK model and quantitative analysis of SC ceramide content revealed that 1 and 10 µM of lycoperoside H increased ceramide[NP] via upregulation of the mRNA expression of CerS3, GCA and GBA. On the other hand, oral administration of lycoperoside H (10 mg/kg) to IL-33Tg mice suppressed the deterioration of skin inflammation and TEWL. In addition, lycoperoside H suppressed infiltration of eosinophils and mast cells, and improves Th2/Th1 cytokine balance in the inflammatory skin region. GR competitive assay demonstrated that lycoperoside H partially binds to the glucocorticoid receptor.

Conclusions: Among 11 isolated compounds from tomato seeds, lycoperoside H was found to improve epidermal dehydration and suppress inflammation in AD mice by increasing ceramides in stratum corneum and anti-inflammatory activity.

Keyword: tomato seed, lycoperoside, steroidal saponin, ceramide, anti-inflammation
Conflict of Interest Disclosure: This work was supported by the New Aichi Creative Research and Development Subsidy.

PAB(T7-131)
Acute and chronic administration of alpha-linolenic acid respectively potentiates nutrient-induced GLP-1 secretion in rats

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Background and objectives: Glucagon-like peptide-1 (GLP-1) is an incretin hormone that enhances insulin secretion leading to suppression of elevated blood glucose levels. Alpha-linolenic acid (ALA) co-administered with glucose is reported to promote GLP-1 secretion. However, the effect of a single administration of ALA, and chronic ingestion of ALA on GLP-1 secretion are unknown. In the present study, we examined the GLP-1 secretory response to a single oral administration of ALA, and the effects of long-term feeding of ALA-rich oil (perilla oil) on basal and postprandial responses of GLP-1 in rats.

Methods: ①Single oral administration study: Male Sprague Dawley rats (5 weeks old) were divided into three groups: dextrin group (4 g/kg body weight), ALA group (27.8 mg/kg body weight), and coadministration group. Blood samples were collected from the tail vein before and after the administration. ②Long-term feeding study: Rats were given either a control diet (C, soybean oil 7%) or a diet containing perilla oil (P, perilla oil 7%). Meal tolerance tests (MTT) were performed to evaluate postprandial GLP-1 responses to a liquid diet administration (15 kcal/kg body weight), at 2 and 4 weeks of feeding period. Rats were dissected 3 days after the 4 weeks-MTT, then, blood and tissue samples were collected.

Result: ①Plasma GLP-1 concentrations were increased by the coadministration of ALA and dextrin, but not by sole administrations. ②Postprandial GLP-1 response at the 4 weeks-MTT tended to be higher in the P group than in the C group. The AUC of GLP-1 concentration was higher, and the time for returning to basal GLP-1 concentrations (duration) was longer, in the P group than in the C group. After the experimental period (> 4 weeks), there were no differences in basal plasma GLP-1 concentration, GLP-1 content and proglucagon mRNA expression levels in the small intestine.

Conclusion: These results suggest that relatively small amount of ALA, not solely, but co-administered with carbohydrate exerts GLP-1 releasing effect, and that long-term ingestion of perilla oil enhances meal-induced GLP-1 secretory response. It is possible that dietary ALA enhances nutrient-sensing function of GLP-1-producing enteroendocrine cells.

Keyword: Glucagon-like peptide-1, Alpha-linolenic acid, Perilla oil

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-132)
Effects of interesterified fat between lard and medium-chain triacylglycerols on gut immunoglobulin A reactivity to gut bacteria and glucose metabolism

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Background and objectives: We have previously demonstrated that excessive lard intake reduces the amount of immunoglobulin A (IgA) coating gut bacteria, and a reduction of IgA coating of gut bacteria may be related to abnormal glucose metabolism accompanied by excessive lard intake. In the present study, we evaluated the effect of lard with modified fatty acid composition on IgA coating of gut bacteria and glucose metabolism.

Methods: C57BL/6 mice were divided into 6 groups and fed lard, medium-chain triacylglycerols (MCT), or medium- and long-chain triacylglycerols (MLCT), which were interesterified fat between lard and MCT, at 7% or 30% w/w in a diet for 8 weeks, respectively (low-lard, high-lard, low-MCT, high-MCT, low-MLCT, high-MLCT group). Fresh feces were collected at week 8 and the IgA-coated fecal bacteria were stained with FITC-labeled anti-IgA antibody and propidium iodide. The average FITC intensity of IgA-coated bacteria was measured by flow cytometer and defined as amount of IgA coating a single fecal bacterium (IgA coating amount). Oral glucose tolerance test (OGTT) was performed to evaluate glucose tolerance. The fasting blood glucose and insulin concentration were measured to calculate the HOMA-IR index for the evaluation of insulin sensitivity.

Results: The IgA coating amount was significantly decreased in high-lard group as compared to low-lard group while no significant difference was observed among low-lard, high-MCT, and high-MLCT group. The incremental area under the curve of OGTT was significantly decreased in high-MCT and high-MLCT group compared to high-lard group. A similar tendency was observed in the HOMA-IR index. Pearson's correlation analysis showed a negative correlation between IgA coating amount and HOMA-IR index (P=0.06, r=-0.33).

Conclusions: Our findings demonstrate that a reduction of IgA reactivity to gut bacteria induced by excessive lard intake is alleviated by interesterification of lard with MCT. Furthermore, the alleviation effect of interesterified fat between lard and MCT on IgA reactivity to gut bacteria may relate to the improvement of abnormal glucose metabolism.

Keyword: Gut bacteria, Immunoglobulin A, Glucose metabolism, High fat diet, Medium- and long-chain triacylglycerols

PAB(T7-133)
Effect of imidazole-dipeptides deficiency on spontaneous motor activity of mice

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Background & Object: Carnosine and anserine are kinds of Imidazole dipeptides (IDs) which are abundant in vertebrate skeletal muscles. However, the physiological function of endogenous IDs in skeletal muscles is not still unclear. Our study was carried out to clarify the effects of deficiency of IDs on spontaneous motor activity of mice.

Methods: We experimented with the 21week old wild type mice (WT) and carnosine synthase gene defected mice (KO). Control diet (10kcal/fat) or high fat diet (60kcal/fat) were used as experimental foods. Food and water were provided *ad libitum* for 6weeks. Body weight was recorded twice a week. Mice were assigned into four groups such as control diet WT, control diet KO, high fat diet WT, and high fat diet KO. Spontaneous motor activity was recorded every minute for 24 hours with *Actimo* (SHINFACTORY Co.).

Result: In control diet group, there is no significant difference in body weight, food intake and water intake of mice between WT and KO groups. And spontaneous motor activity of mice in KO group tended to be higher than that in WT group *(p*=0.057). In high fat diet group, there is no significant difference in food intake and water intake of mice between WT and KO groups. Weight gain in KO group was significantly smaller than that in WT group during the experimental period ($p< 0.05$). Although there is no significant difference in the spontaneous motor activity of mice between WT and KO groups in the dark periods, the spontaneous motor activity of KO group in the light period was significantly higher than that of WT group ($p< 0.05$). This difference in the spontaneous motor activity between both groups seemed to be caused by that of body weight.

Conclusions: In high fat diet to mice, IDs deficiency seemed to affect the body weight gain of mice and enhance their spontaneous motor activity.

Keyword: imidazole dipeptides, spontaneous motor activity, high fat diet, body weight gain, imidazole-dipeptides deficiency

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-134)
Effects of diurnal rhythms of ω-3 fatty acid synthesis pathway biological regulatory functions

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Background and objectives: A daily consumption of high-fat diet induces overweight. On the other hand, ω-3 polyunsaturated fatty acids (PUFA), such as eicosapentaenoic acid (EPA) and docosahexaenoic acid has been reported to have an anti-obese effect. Recently, we have reported that EPA-rich fish oil intake at the end of the active phase maintained physiologically high EPA content using mice model, even if the intake was small. In the present study, we further evaluated that the effects of consumption timing on the physiological changes under the consumption of α-linolenic acid, which is PUFA physiologically converted to EPA.

Methods: On the first experiment, the liver samples were collected from male C57BL/6 mice every 6 hours for 24 hours, and analyzed the diurnal expression of genes concerning with fatty acid metabolism, including ELOVL Fatty Acid Elongase 2 (*Elovl2*) and *Elovl5*, which is factors related to the fatty acid synthesis system. Following, mice were consumed diet composed with ω-3 PUFA-rich perilla oil or ω-9 PUFA-rich olive oil for one week. The hepatic fatty acid composition and gene expression of *Elovl2* and *Elovl5* were analyzed.

Results: Hepatic gene expression of *Elovl2* and *Elovl5* exerted typical diurnal rhythm, with peak at the end of the active period. This diurnal rhythm was conserved on the mice consumed perilla oil, but not olive oil. EPA, which was little in perilla oil, was detected in the liver from mice consumed perilla oil, but almost detection limits in the mice consumed olive oil, which was a little of ω-3 PUFA including EPA. Interestingly, hepatic EPA amount was significantly higher at the end of the inactive period.

Conclusions: The results obtained in this study imply that the physiological system for fatty acid elongation has exert typical diurnal rhythm, and consequently EPA mounts after consumption of α-linoleic acid-rich oil might be affected from the consumption timing.

Keyword: ω-3 polyunsaturated fatty acids (PUFA), ELOVL, EPA, mice, perilla oil

PAB(T7-135)
Efficacy of dewaxed brown rice on the symptoms of seasonal allergic rhinitis; An open-label, randomized, parallel-group comparative pilot study.

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Background and objectives: Dewaxed brown rice (DBR) is prepared by removing the outermost wax layer of brown rice. We have previously reported that DBR activates innate immune system macrophages and alleviates seasonal allergic rhinitis symptoms in mice. However, the effect on seasonal allergic rhinitis in humans has not yet been investigated. Therefore, we examined the effect DBR consumption on pollinosis symptoms in volunteers. recruited from the Nakagawa Hospital in Fukuoka.

Methods: In a parallel-group comparison trial, 28 participants who have experienced pollinosis symptoms in the past 2 years during the pollen season were divided into 2 groups. Participants consumed either white rice (WR, n=15) or DBR (n=13) for 5 months (December to April, 2 meals a day). Once a week during the trial, participants recorded symptoms (runny nose, sneezing, nasal congestion and itchy nose, itchy eyes, watery eyes) using the Japan Rhinitis Quality of Life Questionnaire No.1 (JRQLQ No.1). Medication use was recorded daily. Total nasal symptom medication score (TNSMS) and total ocular symptom medication score (TOSMS) were calculated. To evaluate the difference between symptom scores, the area under the curve (AUC) during the study period was calculated. Based on the AUC of TNSMS and TOSMS, the participants were classified as high or low responders. (Ethics Committee of The University of Nagano: E19-6).

Results: The baseline participant characteristics were not significantly different between the groups. During the pollen season (February to April), the medication score (MS) in the DBR group was significantly lower than in the WR group (Mann-Whitney U-test, $P < 0.05$). In assessing symptom independence, the AUC values for participants consuming DBR were significantly lower than those consuming WR (Fisher's exact test, $P < 0.001$, TNSMS, TOSMS).

Conclusions: Consuming DBR prior to pollen season was effective in reducing the TNSMS and TOSMS for seasonal allergic rhinitis compared to consuming WR. These results suggest that individuals with seasonal allergic rhinitis may be able to manage symptoms by consuming DBR regularly.

Keyword: Seasonal allergic rhinitis, Dewaxed brown rice, Pollinosis, Japan Rhinitis Quality of Life Questionnaire, An open-label, randomized, parallel-group comparative study

Conflict of Interest Disclosure: All authors declare no competing interests. This study has received Dewaxed brown rice, white rice and scholarships from the individuals related to the relevant research.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-136)
Comparison of intestinal absorption profiles of various apigenin glycosides in rats

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Background and Objectives: Flavonoids are widely distributed in plant foods and beverages. Most of the flavonoids have antioxidant and anti-inflammatory activities and are attracting much attention to their health beneficial effects on various disease prevention. In plant foods, flavonoids are present mainly in various glycosidic forms. The basic structure of flavonoid aglycone and the type of sugar moiety bound to one or more hydroxy groups strongly affect their bioavailability. We have investigated the intestinal absorption, lymphatic transport pathways, and metabolism of dietary flavonoids with various chemical structures, especially quercetin and its derivatives. In this study, we compared the bioavailabilities of apigenin derivatives with different glycosidic moieties in rats.

Methods: Apigenin and its glycosides, apigenin-7-O-glucoside (A7-O-G), apigenin-7-O-apioglucoside (apiin), apigenin-6-C-glucoside (isovitexin) and isovitexin-4'-O-glucoside (isosaponarin), were administered intraduodenally to the thoracic lymph-cannulated rats. The collected peripheral plasma, the lymph and the urine were analyzed by UV-HPLC with or without deconjugation treatment.

Results: When A7-O-G and apiin were administered, apigenin was detected in the plasma, the lymph and the urine with deconjugation treatment. The intact aglycone was also detected in the lymph and the urine only in smaller amount, indicating that most of the absorbed apigenin were present as its conjugates after hydrolysis of O-glycosidic bonds. In addition, A7-O-G was absorbed earlier after hydrolyzed by intestinal mucosal enzyme and apiin absorption was observed later probably after the deglycosylation by intestinal microbiota. The apigenin levels in the plasma and the lymph was highest after A7-*O*-G administration compared with apigenin aglycone and apiin administration. Meanwhile, apigenin aglycone was not detected either with or without deconjugation after administration of isovitexin and isosaponarin. Instead, small amounts of these C-glycosides were detected in the plasma and the lymph shortly after administration. Interestingly, a part of isosaponarin was converted to isovitexin in the small intestine.

Conclusion: These results indicate that the absorption amount and the metabolic pattern of apigenin differed, and the physiologically active metabolites may be dissimilar depending on the type of sugar moieties.

Keyword: apigenin, glycoside, intestinal absorption

PAB(T7-137)
Jasmine mixed tea's potential benefits against oxidative stress-related diseases.

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Background and Objectives: Antioxidants have a potential to protect against oxidative stress-related multiple diseases, including cancer, diabetes, and neurodegenerative and cardiovascular diseases when consumed in a long-lasting way through food intake. Jasmine tea is a popular flower tea that has been reported to be effective in treating hypercholesterolemia in rats and preventing the elevation of serum and liver cholesterol as well as the atherogenic index. Other studies demonstrated that jasmine flavored green tea exhibited strong antioxidant and anticancer activities and the increase in scenting process did not significantly affect the antioxidant capacity. Our objective is studying jasmine tea's potential benefits against metabolic diseases, so as an initial step jasmine tea's polyphenolic content and antioxidant activity were investigated to estimate the potential preventive effect against oxidative stress.

Methods: We prepared extracts of jasmine green tea, jasmine black tea, green tea, black tea, or jasmine buds with boiling water. The antioxidant activity was estimated by the radical scavenging ability using DPPH technique. Folin Ciocalteu method was used to compare the polyphenolic content in each extract. HPLC method was used to analyze the polyphenolic contents in extracts.

Results: Jasmine green tea and green tea showed higher antioxidant activity and polyphenolic contents than black teas. Specific DPPH radical scavenging activity per polyphenolic contents were higher in green tea than in jasmine green tea. On the contrary, jasmine black tea showed higher specific activity than black tea. HPLC analysis showed that some polyphenols were enhanced after adding the jasmine scenting, whereas some polyphenols have been reduced. Polyphenolic contents found in the jasmine buds extract were not detected in jasmine green tea but slightly detected in jasmine black tea.

Conclusion: Jasmine scenting process could alter the polyphenolic content and the antioxidant activity on green tea and black tea in different ways. To find the contributor for the alteration of biological activities, using polyphenol standard and a handmade jasmine buds-tea mixture will be helpful for clarification, and eventually proposing various jasmine mixed teas that may have beneficial effects against oxidative stress-related diseases.

Keyword: Polyphenols, DPPH radical scavenging activity, jasmine tea, oxidative stress

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-138)
Anti-cancer effects of Kencur extract on Ehrlich ascites tumor cells

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Background and objectives: Kencur, a tropical plant of the *Zingiberaceae* family, is widely cultured in Asia and its rhizome is used as a spice in various traditional cooking. Previous studies have reported that Kencur prevents hypertension and diabetes. This study aimed to discover new physiological effects of Kencur by assessing the anti-cancer effect of Kencur extract on Ehrlich ascites tumor cells (EATC).

Methods: Kencur extract was prepared by extracting Kencur with 100% ethanol. EATC were incubated with or without Kencur extract (6.25, 12.5 or 25 μg/ml). The anti-cancer effect of Kencur extract was estimated using by Trypan blue exclusion, 2,7-dichlorofluorescin diacetate assay, 5-bromo-2'-deoxyuridine (BrdU) incorporation assay, real-time quantitative PCR, and western blotting. The components of the Kencur extract were analyzed by HPLC.

Results: The Kencur extract suppressed cell proliferation without reducing the cell viability of EATC. In addition, BrdU positive cells were reduced by Kencur extract. The main component of the Kencur extract was ethyl-4-methoxycinnamate (EMC), and EMC exhibited the same anti-proliferative effect as the Kencur extract. EMC decreased the expression levels of TFAM (transcription factor of mitochondrial DNA) and intracellular ROS production levels, and increased the expression levels of Pten (G1 arrest related gene). Furthermore, EMC decreased Ser62 phosphorylation levels of c-Myc, which is a transcriptional regulator of TFAM, by suppressing the expression levels of H-Ras. EMC also increased the expression levels of Mxi1, which inhibits the function of c-Myc.

Conclusions: This study revealed that Kencur extract and EMC exhibit anti-proliferative effect by blocking the G1/S transition of EATC. Furthermore, our results suggested that EMC increased the expression levels of Pten by decreasing mitochondrial-derived ROS levels via reduced transcriptional activity of c-Myc.

Keyword: Kencur, Ethyl-4-methoxycinnamate, Ehrlich ascites tumor cells (EATC), Anti-cancer, G1 arrest

PAB(T7-139)
Effect of the black vinegar drink containing peanut skin extract on glucose and lipid metabolism in high-fat diet-induced obese mice

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Background and objectives: Obesity, which has been increasing all over the world in recent years, increases oxidative stress in our body and leads to the development of metabolic syndrome. Peanut skin is discarded in large quantities due to their low economic value in the peanut industry. However, peanut skin is an attractive material rich in antioxidant polyphenols. We have previously found that black vinegar containing peanut skin extracts have a very high polyphenol content. In this study, we investigated the effect of the black vinegar drink containing peanut skin on glucose and lipid metabolism in high-fat diet-induced obese mice.

Methods: Six-week-old male C57BL/6J mice were divided into three groups depending on the sample provided as a drink; water (control group), 40-fold dilution (low dose (LD) group) or 20-fold dilution (high dose (HD) group) of the black vinegar drink containing peanut skin. Mice were fed with a 60%kcal high fat diet for 19 weeks. Mice were sacrificed one week after the oral glucose tolerance test.

Results: The final body weight of LD and HD groups were significantly decreased compared with control group ($p = 0.01$ and $p = 0.05$, respectively).

Conclusions: The results of this study suggest that ingestion of black vinegar drink containing peanut skin may help to prevent high-fat diet-induced obesity and development of metabolic syndrome.

Keyword: peanut skin, black vinegar drink, obesity, glucose and lipid metabolism

Conflict of Interest Disclosure: This study is funded by Yamasu Inc.
Seiji Suwa is president of Yamasu
Keita Imai is an employee of Yamasu Inc.

Further Collaborators: Non

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-140)
Infants may be exposed to quercetin and its metabolites *via* breast and formula milk

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Background and objectives: Quercetin (QUE) is converted into various metabolites by mechanisms of drug metabolism. Blood and urine have so far been conventionally used to evaluate the bioavailability of QUE. However, it has recently been shown that flavonoids, including QUE, are also present in human breast milk[1]. It is important to note that previous studies have not elucidated the presence of aglycones in breast milk because they used deconjugation enzymes for analyses. In addition, the concentrations of flavonoids in the blood and breast milk of one individual have never been compared. In this study, we aimed to quantify QUE and its metabolites in biological samples of maternal and neonatal mice.

Methods: Both male and female ICR mice, divided into a control and a 1%-QUE-fed group, were allowed to mate and delivery. Breast milk was then collected from maternal mice once or twice by postnatal day 11-13, and then blood and urine from maternal and neonatal mice were obtained. Each sample was treated with or without the deconjugation enzyme sulfatase H-1. QUE and its metabolites were quantified by LC-QTOF-MS/MS analysis.

Results: QUE and its metabolites (isorhamnetin, QUE-3-glucuronide and QUE-3'-sulfate) were detected in breast milk, blood and urine of maternal mice in the QUE group. Interestingly, the concentrations of QUE in breast milk were estimated to be 7 times as high as those in blood. Besides, QUE was present in the blood and urine of neonates. Therefore, our results suggest that QUE was transferred from maternal to neonates *via* breast milk. In addition, we found that QUE aglycone was present in commercial infant formula.

Conclusions: In this study, we have demonstrated for the first time the presence of QUE and its metabolites in the biological samples of QUE-fed maternal mice and their infants. As QUE was also present in formula milk, infants may be exposed to QUE in both cases that they intake either breast or formula milk. The levels of drug-metabolizing enzymes of the QUE exposed infants are currently investigated.

Keyword: quercetin, flavonoid, breast milk, formula milk, LC-QTOF-MS/MS

1) Song et al. *Nutrition,* 29, 195-202 (2013)

PAB(T7-141)
Effect of soybean hull product on obesity and gut microbiome in high-fat diet induced obese mice

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Background and objectives: In recent years, the global obesity population has increased rapidly. Obesity increases the risk of developing cardiovascular diseases, therefore it is important to prevent or ameliorate obesity. Soybean hulls are by-product produced during the processing of soybean products. Although soybean hulls contain a high content of dietary fibre, most of them are wasted. Several studies have reported that the intake of dietary fibre improves high-fat diet induced obesity and gut microbiome composition, however few studies have reported about the effect of soybean hulls on obesity and microbiome. Therefore, in this study, we investigated the effects of soybean hull product on obesity and gut microbiome in high-fat diet induced obese mice.

Methods: 7-week-old male C57BL/6J mice were fed a standard diet (ST), a high-fat diet (HFD), or HFD with 5% (w/w) or 10% (w/w) soybean hull product (5% or 10%) for 10 weeks. After 10 weeks of the respective dietary treatment, mice were sacrificed. For the measurement of fecal short chain fatty acids (SCFAs) contents and the analysis of gut microbiome composition, feces were collected at 10 weeks of treatment. The gut microbiome composition was analyzed by 16S rRNA gene sequencing.

Results: Dietary supplementation of 10% soybean hull product significantly reduced the body weight gains, weights of subcutaneous, epididymal, and perirenal adipose tissues compared to the HFD group. In 10% group, the content of major SCFAs such as acetate, propionate, and butyrate significantly increased. Furthermore, the overall gut microbiome composition changed with the dietary treatment, especially 10% group showed the significant increase of the relative abundance of potentially beneficial bacteria such as SCFAs producing bacteria.

Conclusions: Consumption of soybean hull product suppressed the weight gain and fat accumulation caused by a high-fat diet intake and altered gut microbiome composition. These results suggest that soybean hull product can be a functional food material which helps prevent high-fat diet induced obesity and utilize wasted food material.

Keyword: soybean hulls, obesity, gut microbiome, dietary fibre, SCFAs

Conflict of Interest Disclosure: This study is funded by Showa Sangyo Co., Ltd.

Takuya Asaoka and Yuka Miki are employees of Showa Sangyo Co., Ltd.

Further Collaborators: Non

PAB(T7-142)
Anti-cancer effect of nucleic acids and its mechanism

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Background and objectives: It has been clarified that nucleic acids have various physiological activities such as catalysis of certain biochemical reaction and regulation of certain activity in cells. We have already reported that DNA-rich nucleic acid prepared from salmon milt (DNSM) has protective effect against ethanol-induced liver injuries in rats. In this study, we investigated that anti-cancer effect of nucleic acids.

Methods: We evaluated nucleic acids for its anti-tumor activity against the Ehrlich ascites tumor (EAT) *in vivo* and *in vitro*. EAT-bearing mice was used for *in vivo* system. DNSM and RNA as a sample, was ingested orally. For *in vitro* experiments, DNSM, RNA, or nucleosides such as adenosine, guanosine, 2-deoxyguanosine, cytidine and uridine were used. Cell viability, cell proliferation and cell cycle were analyzed. The expression levels of cell cycle-related genes and proteins were measured by real-time quantitative PCR and western blotting.

Results: When DNSM or RNA was added to the medium of EAT cells, RNA showed anti-cancer effect, but DNSM did not affect cell viability and proliferation. On the other hand, in *in vivo* experiments, oral administration of DNSM or RNA significantly reduced ascites in mice, suggesting the digestive products, which are created by the degradation of DNSM by nucleases in the intestine, showed anti-cancer effect. Furthermore, in order to reveal for the active component of the anti-cancer effect of nucleic acid, cell proliferation of EAT cells was measured. Among each nucleoside, guanosine and 2-deoxyguanosine significantly suppressed the cell proliferation via G1 arrest of cell cycle.

Conclusion: It was suggested that the active component of the anti-proliferative effect by nucleic acid is guanosine and 2-deoxyguanosine.

Keyword: Nucleic acids, Guanosine, Anti-cancer, Ehrlich ascites tumor (EAT) cells, G1 arrest

Conflict of Interest Disclosure: A part of the research grant and nucleic acids were provided by Fordays, Co., Ltd. We declare that these relationships do not affect the results and conclusions of this study.

PAB(T7-143)
Valorization of *Prinsepia utilis* byproducts for alleviating anti-aging stress and skin revitalization

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Background and objectives: The interest of the cosmetic industry in natural bioactive compounds for their use in nutricosmetic and cosmeceutical products is increasing. Natural products-based cosmetics reduce skin aging and inflammation and protect from UV radiation. As a result, nutricosmetics and cosmeceuticals are becoming innovative self-care products in the cosmetics market. Among others, wild edible fruits are gaining popularity due to their nutraceutical and cosmeceuticals properties; and *Prinsepia utilis* (*P. utilis*) is the case of this study as it is considered a good source of fatty acids, vitamins, bioactive compounds, and antioxidants. The present study aims to study the potential of *P. utilis* with regards to (i) extraction and characterization of oil and its antioxidant activity, and (ii) optimization of antioxidant polyphenolics of leftover oil residue using green extraction for possible applications in the nutricosmetics industry.

Methodology: The seed powder was extracted using hexane with soxhlet and analyzed using GC-MS. The leftover oil residue is optimized through Response Surface Model (RSM) using UAE. Standard methods were used for analyzing the antioxidant and anti-aging activity of the seeds and leftover oil residue.

Results: The GC-MS results highlight the presence of many health-promoting compounds, i.e., fatty acid, phytosterols, and tocopherols. The ABTS antioxidant activity of oil attained IC_{50} at 904.11 µg/ml, which is beneficial to inhibit the free radicals. Under optimum extraction conditions, total phenolics, flavonoids, tannins, and antioxidant activity were closed with the model predicted values. HPLC-PDA analysis detects ten polyphenolic compounds under optimized extraction conditions. The anti-aging activity indicated that extract is good in inhibition of tyrosinase (IC_{50} 1.81± 0.02 mg/ml) and hyaluronidase (IC_{50} 0.90±0.03 mg/ml) enzyme. The extract prevented UV damage and showed good sun protection (SP) value (11.00±0.03) at a dose of 1000µg/ml

Conclusion: The study provides the potential use of leftover residue in water, which can be used for higher antioxidant activity and alleviating oxidative stress. The oil residue can be utilized for skincare, nutraceuticals pills, and functional food.

Keyword: Wild edibles, Fatty acids, Polyphenols, Antioxidant activity, Skin aging

Conflict of Interest Disclosure: The authors do not have any conflicts of interest

Further Collaborators: No

PAB(T7-144)
Absorption and Tissue Distribution of 3-(4-hydroxy-3-methoxyphenyl) propionic acid, a flavonoid metabolite, in Rats

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Background and Objectives: 3-(4-Hydroxy-3-methoxyphenyl) propionic acid (HMPA) is an end-product of flavonoids in the gut system by microbiota. Although the intake of flavonoids caused diverse physiological events, pharmacokinetics as well as bioactivity of their metabolite HMPA remain unclear. In this study, we thus tried to clarify the bioavailability of HMPA in Sprague-Dawley (SD) rats for further study regarding physiological potential of HMPA and/or its metabolites in accumulated organs.

Methods: A single oral administration of HMPA (10 mg/kg) was performed in 8-week-old male SD rats. Blood samples collected from the tale vain at 0, 0.25, 0.5, 1, 2, 4, and 6 h after the administration, following the collection of organs (the liver, kidneys, heart, lungs, soleus muscle, and abdominal aorta) at each sampling schedule. Blood and tissue samples were subjected to an LC-TOF/MS to determine HMPA and its possible metabolites of sulfated (HMPA-S) and glucuronided (HMPA-GlcA) conjugates.

Results and Discussion: An intact absorption of HMPA into SD rat circulating bloodstream was observed up to 6 h after the administration (10 mg/kg). The pharmacokinetics obtained in this protocol (T_{max}: 0.25 h, $T_{1/2}$: 0.18 h, C_{max}: 5.8 ± 0.8 nmol/mL) indicated a rapid absorption and disappearance of HMPA in blood system. LC-TOF/MS analysis of blood (plasma) samples also revealed the compatible absorption of HMPA conjugates (HMPA-S, 3.8 ± 0.4 nmol/mL; HMPA-GlcA, 1.3 ± 0.2 nmol/mL) to intact HMPA (5.8 ± 0.8 nmol/mL), suggesting a rapid and significant phase II-metabolism of HMPA before entering bloodstream. In target organs, HMPA (e.g., liver at 2 h: 0.33 ± 0.33 nmol/g-tissue) and HMPA-S (0.042 ± 0.023 nmol/g-tissue) were detected up to 6 h after administration, while no detection of HMPA-GlcA was observed after 4 h (liver at 2 h: 0.0014 ± 0.0014 nmol/g-tissue).

Conclusion: This study demonstrates that a flavonoid metabolite in the gut, HMPA, was rapidly absorbed and accumulated in circulating blood and organs for a long period of 6 h, along with sulfation and glucuronidation metabolism. The impact of this finding leads us to further study on their physiological roles in accumulated organs.

Keyword: flavonoid metabolite, bioavailability, absorption, distribution

PAB(T7-145)
Effects of curcumin and low carbohydrate diet on testicular antioxidant capacity, cell apoptosis and spermatogenesis in male mice

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Background and objectives: The aim of this study was to investigate the effects of Curcumin supplementation on low carbohydrate diet (LC) diet-induced metabolic dysfunction, testicular antioxidant capacity, apoptosis, inflammation and spermatogenesis in male mice.

Methods: Male C57BL/6 mice were fed normal diet (AIN-93M group, n=12) or LC group (fed with low carbohydrate diet, n=48) for 12 weeks and mice randomly chosen from the LC group were later kept original diet (LC group, n=12), changed into AIN-93M feed (LC/AIN-93M group, n=12) or ketogenic diet (LC/KD group, n=12) or ketogenic diet treated with curcumin (LC/KDCu group, n=12) for the final 6 weeks.

Results: A poor sperm morphology and the mean testicular biopsy score (MTBS) were observed in the LC and LC/KD groups, but this was eliminated by the normal diet or ketogenic diet with curcumin. The LC group exhibited a lower testicular testosterone level and a lower 17β-HSD activity and protein expression. The LC group exhibited enhanced apoptosis protein expressions in testis tissue, including Bax/BCl_2, cleaved caspase 3 and cleaved PARP, and higher inflammation protein expressions, NF-κB. The LC group exhibited a statistically-significant increasing in lipid peroxidation and decreased superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase level as compared with other groups. The LC diet induced hyperlipidemia in mice, which developed metabolic dysfunction and poor semen quality.

Conclusions: Overall, the results showed that a normal diet or ketogenic diet treated with curcumin attenuated oxidative stress and improved the semen quality reduced by the LC diet.

Keyword: low carbohydrate diet, curcumin, oxidative stress, male infertility, spermatogenesis

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-146)

Bioavailability of organic acids and phenolic compounds by ingestion of *Hibiscus sabdariffa* BEVERAGE: effect on inflammation markers as a potential immunomodulator for sars-cov-2 disease

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Background and objective: The severe acute respiratory syndrome (SARS-CoV-2) is characterized by an inflammatory response exacerbating cytokine production. The worldwide affected population is about 162,773,940 cumulative confirmed cases by WHO. *Hibiscus sabdariffa (HS)* is a common ingredient used in Mexican cuisine that has shown antioxidant, anti-inflammatory, anti-hypertensive, anti-microbial, anti-convulsant, and hypoglycemic properties. Due to its potential anti-inflammatory, *HS* might represent a potential coadjuvant treatment for SARS-Cov-2. This study aims to evaluate the bioavailability of the bioactive compounds in an *HS* shot-type beverage and its possible effect against acute infection SARS-CoV-2 disease.

Methods: An acute single-blind crossover trial with at least six days of washout period, in which twelve volunteers consumed a shot of 60 mL drink based on HS, agave fructans and mint, or a placebo. After consuming the beverages, participants received a Western diet, and blood samples were collected at 0, 0.5, 1, 2, 3, 4, 5, and 6h, as well as urine samples at 0, 3, 6, 12, and 24h. The bioavailability of antioxidant compounds in plasma and urine were evaluated by High-Performance Liquid Chromatography coupled to a mass spectrometer (HPLC-DAD-MS) (Agilent 1260).

Results: The *HS* beverage appear to be multifunctional, with the participation of different bioactive compounds identified as bioavailable; within the most abundant in plasma and urine were organic acids such as hibiscus acids, hydroxycitric acid, hibiscus dimethyl ester, and trimethylhydroxycitric acid. The cinnamic acids such as chlorogenic acid and gallic acid in plasma are some of the potentially bioavailable compounds that can interact with different biological targets to cause possible anti-inflammatory effects.

Conclusions: Many *in-vivo* and *in-vitro* studies have shown the immunosuppressive effect of aqueous *HS* beverages. The bioavailability of the bioactive constituents of HS needs to be considered, involving different bioactive agents which can interact with different biological targets to elicit the observed anti-inflammatory effects, which will serve to generate strategies to counteract COVID19 disease.

Keyword: Bioavailability, anti-inflammatory, SARS-CoV2

Conflict of Interest Disclosure: All authors declare there is no potential conflict of interest to disclose

PAB(T7-147)

Bioactive compounds in the peel, arils, and juice of pomegranate fruits Punica granatum in Mexico

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Background and objectives: The pomegranate (*Punica granatum* L) is a "superfruit" and is considered a nutraceutical food due to the large number of polyphenols that provide nutraceutical, organoleptic and antioxidant properties. This research aimed to evaluate the content of total phenols, anthocyanins, punicalagin, and antioxidant capacity by the ABTS, DPPH methods, and the peel, arils, and fruit juice of five varieties of pomegranates from southern Jalisco, Mexico.

Methods: The varieties included in this study were sweet pomegranates (Apaseo and Isais), sweet-sour (Wonderful), and sour (Chichona and Verde). Total polyphenol contents (TPC), mg gallic acid equivalents per 100g dry weight (mg GAE/100g DW) and Trolox equivalent antioxidant capacity (TEAC, µmol/g) by the ABTS and DPPH method, total anthocyanin content (TAC, mg cyanidin-3- glucoside equivalents per 100 g DW (mg CGE/100d DW) and punicalagin content (PC, mg/g DW) were evaluated.

Results: The results show that the varieties evaluated have a high TPC (805.9-5599 mg/GAE/100g DW), TEAC (582.89-1419.09 mM TEAC/100g DW), TAC (8.38-34.056 mg CGE/100g DW). The Chichona variety has the highest TPC, TEAC, and punicalagin, while the Wonderful variety has the highest total anthocyanins. The TPC (19206.3 mg/GAE/100 g DW) is statistically higher in the peel than in aril and juice with 869.4 and 286.4 mg/GAE/100 g DW, respectively. TEAC by the DPPH method also showed higher values in the peel than aril and juice 2533.70 vs. 149.95 and 42.19 mMol TE/100mg, respectively; similarly, the same trend was presented for TEAC by the ABTS method. In contrast, the total content of anthocyanins in juice and arils was the same with 18.2259 and 17.4766 mg CGE/100g DW, respectively, and the peel was obtained the lowest anthocyanins with a value of 1.5858 mg CGE/100g DW.

Conclusions: In conclusion, it is considered that the fruits of the pomegranate varieties evaluated show to be a powerful antioxidant, especially in the peel, reflected in higher TPC, TEAC, and punicalagin content, although anthocyanins presented higher values in arils and juices.

Keyword: DPPH, ABTS, Total phenols compounds, Punicalagin, anthocyanins

PAB(T7-148)
Antioxidant Activity, Total Phenolic Content and Organic Acids of Winter Melon Aqueous Extract

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Background and objectives: Winter melon (*Benincasa hispida)* is one of the vegetable crops planted in dry lowland tropical areas. It is a species in the cucurbit family that is primarily grown for its fruits. Mostly in Asian countries, winter melon has been valued as a nutritious vegetable and traditionally applied to treat various ailments such as anti-ulcer, anti-inflammatory, anti-diarrheal, among others. This study aimed to determine antioxidant activity and total phenolic content at three edible fruit maturity stages and to identify the presence of polyphenolic compounds and organic acids in winter melon aqueous extract.

Methods: Malaysian-grown round fruits of winter melon were collected at 45, 56, and 70 days after planting. The fruit pulp was extracted in filtered water at 60℃ for 30 minutes and dried at 55℃ in an oven for 48 hours. Antioxidant activity and total phenolic content of the extract were determined by 2,2-diphenyl-1-picrylhydrazyl (DPPH) and Folin-Ciocalteu assays, respectively. The liquid chromatography quadrupole time-of-flight-mass spectrometer (LC-QTOF-MS) was used to identify compounds in the selected extract.

Results: Aqueous extract of winter melon fruit collected at day 56 exhibited significantly higher free radical-scavenging activity and total phenolic content compared to extract from fruits collected at day 45 and 70. There was a negative correlation between IC50 value and total phenolic content. A total of 15 compounds were identified in the extract of fruit collected at day 56 when subjected for further analysis using LC-QTOF-MS. Other than polyphenolic compounds like 6-gingerol, the extract was also found to be rich in organic acids namely citric acid, fumaric acid, and glutaric acid. The presence of these polyphenols and organic acids might be responsible for the antioxidant activity in winter melon aqueous extract. Citric acid is the most abundant compound identified. Inositol, a natural sugar, was also detected in the extract.

Conclusions: Overall, this study suggested good polyphenols, organic acids, and antioxidant activity potential in winter melon aqueous extract. Future research may focus on its application in nutraceutical and pharmaceutical sectors.

Keyword: antioxidant, maturity stage, organic acid, phenolic content, winter melon.

PAB(T7-149)
Intranasal administration of eugenol alleviates high-energy diet-induced cognitive impairment

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Background and objectives: High energy dietary intake may be harmful to cognitive, and nasal inhalation of spices is an effective means of acting directly on the brain. Eugenol is widely used to inflammation and dietary interventions for metabolic disorders. However, the protective effect of inhaled eugenol on cognitive functions is not fully clear. In this study, we evaluated the protective effect of inhaled eugenol on cognitive impairment through a high-energy diet animal model.

Methods: Fifty 6-week-old C57BL/6J male mice were divided into five groups (n=10/group): The Control group (Control) (Fed with a standard diet, AIN93), the Control +high dose eugenol group (Con-eu) (standard diet with 10 mL, 10mg kg^{-1} day^{-1} body weight, nasal drip of eugenol), the HFFD group (HFFD) (Diet 60% kcal from fat, 10% fructose in drinking water, 10 mL drip of saline), the Low dose eugenol group (LE) (HFFD diet with 10 mL, 5 mg kg^{-1} d^{-1} body weight nasal drip of eugenol), the high dose eugenol group (HE) (HFFD diet with 10 mL, 10 mg kg^{-1} d^{-1} body weight nasal drip of eugenol). After 14 weeks of eugenol administration, the degree of cognitive impairment in mice was assessed by water maze, open field, and new object recognition behavioral assays

Results: Nasal administration of eugenol significantly reduced weight gain and insulin resistance in HFFD-fed mice. Low doses of nasal administration of eugenol significantly prevented HFFD-induced neuronal loss and memory impairment. Immunofluorescence staining of hippocampal showed that apoptosis marker protein cleaved caspase-3 expression was significantly enhanced in HFFD group, whereas expression was significantly lower in the nasally administered eugenol group. Transcriptomic results showed that inhalation of eugenol significantly inhibited the expression of *Lnc-Snhg16* gene and increased the expression of anti-apoptotic gene BCL-2 by activating IRS/AKT phosphorylation. Flow cytometric results showed that 100 mM eugenol significantly ameliorated high glucose-induced apoptosis in hippocampal HT22 cells, and the ameliorating effect of eugenol on apoptosis was inhibited after si *LncSnhg16*.

Conclusion: Nasal administration of eugenol is a way to prevent high-energy density diet-induced cognitive impairments, which could be possibly explained by their mediating effects on insulin signaling in the brain.

Keyword: eugenol, nasal, inhalation, hippocampal apoptosis

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-150)

Cyclic nigerosylnigerose attenuates colonic inflammation and abnormal glucose metabolism as well as promotes gut bacteria-specific IgA secretion in diet-induced obese mice

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Background and objectives: Prolonged intake of a high-fat diet (HFD) impairs gut barrier function, which relates to exacerbation of low-grade inflammation and insulin resistance (IR) in peripheral tissues. Furthermore, HFD feeding reduces the amount of gut IgA coating gut bacteria and a reduction of IgA coating relates to HFD-induced IR. We previously showed that oral administration of cyclic nigerosylnigerose (CNN), a cyclic sugar, ameliorates gut inflammation symptoms and promotes IgA coating of gut bacteria. In this study, we investigated the effect of CNN, especially on gut inflammation, glucose metabolism, and gut bacteria-specific IgA secretion in diet-induced obese mice.

Method: Balb/c mice were divided into 3 groups including normal-fat diet (NFD)-fed group, HFD- fed group, and HFD-fed and CNN-administered (HFD+CNN) group. CNN-supplemented water (45 mg/mL) was given to HFD+CNN group. Before dissection, the fasting blood glucose and insulin concentration were measured to calculate the HOMA-IR index. At week 20, mice were sacrificed and the colonic tissues and fresh feces were collected. The *Tnfa* gene expression in the colonic tissue was measured by qPCR. The total amount of IgA coating fecal bacteria (μg/g feces) (a) was measured by immunoblotting. The fecal IgA concentration (μg/g feces) (b) was measured by ELISA. The ratio of (a) to (b) was calculated to predict how much amount of IgA was specific for gut bacteria.

Results: The HOMA-IR index was significantly lower in NFD and HFD+CNN group than HFD group. The gene expression of *Tnfa* was significantly lower in NFD and HFD+CNN group than HFD group. The fecal IgA concentration was significantly lower in HFD+CNN group than HFD group while the total amount of IgA coating fecal bacteria tended to be higher in HFD+CNN group. The ratio of (a) to (b) was significantly higher in HFD+CNN group than NFD and HFD group.

Conclusion: CNN attenuates colonic inflammation and abnormal glucose metabolism accompanied by long-term HFD feeding. CNN increases a ratio of IgA specific for gut bacteria in fecal IgA. It remains unclear whether gut bacteria-specific IgA induced by CNN contributes to the improvement of colonic inflammation and abnormal glucose metabolism.

Keyword: cyclic sugar, high-fat diet, glucose metabolism, immunoglobulin A, gut bacteria

PAB(T7-151)

Dietary oleic acid modulates satiety by mobilizing intestinal oleoylethanolamide signaling

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Background and objectives: Oleoylethanolamide (OEA) is a lipid mediator with homeostatic functions in appetite regulation and fat metabolism through peroxisome proliferator-activated receptor-α. Accumulating data suggest that luminal oleic acid (OA) can be sensed by cluster of differentiation 36 expressed in gastroenterocytes and then converted to OEA via the N-acylphosphatidylethanolamine-dependent pathway, resulting in satiety induction.

Methods: In this study, we investigated how dietary fat or OA affects OEA biosynthesis and food intake in mice, using three diets—OA diet (38 mg OA/g diet, 7% fat, OAD), low OA diet (3 mg OA/g diet, 7% fat, LOAD), and high fat diet (200 mg OA/g diet, 36% fat, HFD).

Results: LOAD feeding caused reduction in jejunal OEA levels and increase in food intake compared with OAD feeding. This effect of LOAD was observed even on the first day of feeding. OEA treatment diminished the effects of LOAD feeding. Furthermore, lipid or OA infusion into the upper gut stimulated jejunal OEA production and reduced food intake. In contrast, HFD feeding reduced intestinal OEA production even though the diet contains 5 times more OA than OAD.

Conclusions: Collectively, these findings suggest that dietary OA induces meal satiety via intestinal OEA production, but the effects is depending on the total fat amount of the meal, indicating that balanced dietary fat intake is important in controlling feeding behavior through intestinal OEA signaling.

PAB(T7-152)

Discovery of novel human metabolites, dimethylated rosmarinic acids (DiMe-RAs), after oral intake of *Perilla frutescens purpurea* extract and their inhibitory activity on TRPV4

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Background and objectives: Rosmarinic acid (RA) is a dietary polyphenol abundant in *Perilla frutescens purpurea* and known to exhibit various health-promoting effects. In recent years,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

polyphenol metabolites have attracted great interest as some of them showed higher biological potencies rather than the parent compounds. In a previous study concerning methylated RA, only a monomethylated RA (MonoMe-RA), which is methylated at phenolic hydroxyl group of RA, was reported as a metabolite after oral administration of RA in rat plasma; however, detailed methylation metabolism of RA and their biological activities have not been fully investigated. Therefore, we focused on the methylation behavior of RA and developed an analytical method to quantify methylated RAs including unidentified isomers of MonoMe-RA and dimethylated RA (DiMe-RA) as well as reported RA metabolites. Furthermore, as an example to demonstrate the functionality of the metabolites, inhibitory activities of methylated RAs were tested against TRPV4, which is recognized as a therapeutic target for treatment of inflammatory and neuropathic pain.

Methods: Synthetic standards of Mono/DiMe-RAs and a UHPLC-MS/MS method were prepared for quantification. A crossover study was conducted to examine the pharmacokinetics of *Perilla frutescens purpurea* leaf extract (PE) containing RA in healthy human volunteers. After a single oral dose of PE 442 mg containing RA 100 mg or placebo, the urine and plasma were collected from 0 to 24 h and quantitatively analyzed. Several Mono/DiMe-RAs were tested in an *in vitro* cellular assay to evaluate inhibitory activity on TRPV4.

Results: The quantification result of collected human plasma and urine showed metabolic production of DiMe-RAs after oral intake of PE as novel and prime metabolites, while 4,3'-DiMe-RA was the most abundant metabolite among them. In a biological assay, the DiMe-RA showed inhibitory potency on TRPV4.

Conclusions: The present research clarified human pharmacokinetics and metabolism of RA focusing on the methylated RA. Further physiological activities of methylated RAs will be investigated aiming to develop self-medication products such as functional foods. This study showed that the preparation of potential metabolites as original compounds would be a promising way to elucidate not only overall metabolism but also unknown biological activities of target compounds.

Keyword: rosmarinic acid, methylation, perilla, pharmacokinetic analysis, TRPV4

PAB(T7-153)
Use of Superfoods in Infants and Young Children Nutrition in Africa: a systematic review

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Background and objective: African communities have diverse complementary feeding options but also practices that may interfere with optimum child nutrition and growth. This review assessed the contributions of macronutrient, and micronutrients intake, nutritional status and long-term effects of superfoods (food with exceptional nutrient content) intake among African children 6-24 months.

Methods: We searched through PUBMED, EMBASE, CINAHL and African Index Medicus databases. Further, grey literature were extracted from Google scholar published articles. Population, intervention, control and outcomes (PICO) terms to create MeSH terms targeting children 6-24 months. The reporting of this review followed the PRISMA guidelines and was registered on Prospero [CRD42021240697].

Key findings: Out of 3,758 papers pulled, 24 papers from 10 countries published between 1999 to 2020. Overall, 18 of the papers used an experimental design and remaining 6 were observational studies. The most common superfoods used in child feed were soybeans flour, and orange-fleshed sweet potatoes. Soybean use was most associated with weight gain and length after 3 months of implementation. Soybean combined with other foods such as corn-soy blends, weight gain effects were still observed, however no significant gains were observed in length gain or stunting rates. Orange-fleshed potatoes significantly improved vitamin A intake and serum vitamin retinol levels. Only one intervention study reported on the use of hibiscus leaf intake and this had a low significant increase in length for age among children 6-24 months. Stunting rate in this population increased by 1.4% in the intervention compared to 5.1% in the control group. Similarly, spirulina incorporated in maize porridge in another study had an impact on length and weight gain and significantly reduced likelihood of developing coughs and child motor development such as walking alone without support at 15 months of age.

Conclusion: Superfoods such as soybean, spirulina and hibiscus used alone or added to grains in complementary foods have potential to increase anthropometrics indicators among young children, while sweet potatoes and hibiscus increased serum retinol levels and motor development. To obtain optimum benefits of superfoods in physical and motor development among young children a combination of these foods may be beneficial.

Keyword: Superfoods, complementary feeding, nutritional status, growth and development, Africa

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-154)
Anti-obesity effect of Kencur, *kaempferia galangal* L., extract

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Background and objectives: Obesity is a major risk factor for various chronic diseases, such as diabetes, cardiovascular disease and cancer. Therefore, it is very important to find an effective way to prevent obesity. Kencur, a plant of the *Zingiberaceae* family, is mainly cultivated in Southeast Asian countries. It has been already reported that Kencur has antioxidant and anti-inflammatory effects. However, the anti-obesity effect of Kencur has not been yet clarified. Therefore, we investigated the anti-obesity effect as a new physiological activity of Kencur.

Methods: Kencur was extracted with 100% ethanol and concentrated to dryness using a vacuum evaporator. We investigated the effect and mechanism by which Kencur extract inhibits the differentiation of 3T3-L1 preadipocytes into adipocytes. 3T3-L1 preadipocytes were cultured for 8 days after adding a sample at a various stages of inducing differentiation. The amount of intracellular triglyceride (TG) and the activity of glycerol-3-phosphate dehydrogenase (GPDH), a rate-limiting enzyme of TG synthesis, were estimated. Furthermore, the expression levels of transcription factors, PPARγ, C/EBPα and C/EBPβ, involved in adipocyte differentiation were measured by Western blotting and real-time quantitative PCR.

Results: Kencur extract was analyzed with HPLC and found that the main component in Kencur extract is ethyl-4-methoxycinnamate (EMC). Kencur extract and EMC suppressed the TG accumulation and GPDH activity in a dose-dependent manner, suggesting that EMC acts as the active component for the effect of the Kencur extract. In addition, when EMC was cultured at different timings, TG accumulation was significantly suppressed by adding it 2 days after the induction of differentiation. Furthermore, the gene expression levels and protein expression levels of PPARγ, C/EBPα, and C/EBPβ were significantly reduced by the addition of EMC.

Conclusions: Our results showed that Kencur extract suppresses the TG accumulation in 3T3-L1 preadipocytes by reducing the expression of transcriptional factors that promote differentiation in the early stage of the differentiation process. These results suggest that Kencur extract is useful for anti-obesity.

Keyword: Kencur, 3T3-L1 preadipocytes, Ethyl-4-methoxycinnamate (EMC), Transcriptional factors, Anti-obesity

PAB(T7-155)
Milk fermented by lactic acid bacteria enhance dietary carotenoid bioavailability in humans in a randomized crossover trial.

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Background and objectives: Dietary carotenoids have beneficial health effects because of their antioxidant and anti-inflammatory properties. In humans, the bioavailability of β-carotene from carrots or spinach ranges from 3–16%. Therefore, it is important to increase the bioavailability of dietary carotenoids in order to maximize their potential for health effects. The aim of this study was to evaluate the effect of fermented milk on the bioavailability of dietary carotenoids in humans.

Methods: Three studies were conducted using a randomized, crossover method. The study subjects (N=16/study) consumed a test drink on two separate days with a two-week washout period. Subjects consumed a vegetable (carrot, tomato, or spinach) drink alone or with a fermented milk. Fermented milk was produced by incubating *Lactobacillus delbrueckii* subsp. *Bulgaricus* OLL1251 and *Streptococcus thermophilus* OLS3290 with 10% nonfat skimmed milk powder. Blood samples were collected before the test drink was consumed (0 h) and again 2, 4, 6, 8 h after ingestion. Aliquots of fresh plasma from each blood sample were processed to isolate the triacylglycerol-rich lipoprotein (TRL fraction) because the postprandial carotenoid content in the TRL fraction of plasma is elevated. Plasma carotenoid concentrations were quantified using a HPLC.

Results: A significantly higher $iAUC_{0\text{-}8\ h}$ for β-carotene, α-carotene, retinyl palmitate was observed in the TRL fraction of plasma when carrot + fermented milk was consumed compared with carrot alone (β-carotene: 1.8-fold change). For lycopene, the $iAUC_{0\text{-}8\ h}$ of the TRL fraction of plasma was significantly larger in the group that consumed tomato combined with fermented milk versus the groups that consumed tomato alone (6.5-fold change). The iAUC for lutein in all plasma fractions was significantly higher for the group that consumed spinach + fermented milk compared to the spinach alone group. A significantly larger $iAUC_{0\text{-}8\ h}$ for β-carotene and retinyl palmitate was observed in the TRL fraction of plasma when spinach + fermented milk was consumed compared with spinach alone.

Conclusions: Co-ingestion of β-carotene and fermented milk significantly increased dietary carotenoid bioavailability in humans. These findings may provide new methods to increase dietary carotenoid bioavailability.

Keyword: fermented milk, carotenoids, bioavailability, lactic acid bacteria, humans

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-156)
Metabolites profile of sea grapes (*Caulerpa racemose*) soxhlet extract: A Study Untargated Metabolomic Profiling

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Background and objectives: Sea grapes (*Caulerpa racemosa*) is a green seaweed that currently gaining attraction due to its potential health benefits. The identification of sea grapes' major constituents is required to profile its biological activities and therapeutic potentials. This study aims to analyze the metabolomics of sea grape Ethanolic-Soxhlet extract via liquid chromatography-high resolution mass spectrometry (LC-HRMS).

Methods: Fresh samples of Seagrapes underwent Ethanolic Soxhlet extraction and subsequently untargeted metabolomics analysis by LC-HRMS. Compounds were identified utilizing Compound Discoverer with mzCloud MS/MS Library.

Results: The Top 25 major constituents of sea grapes extract were identified. Betaine, a compound commonly used in homocystinuria treatment, was present as the top metabolite of sea grapes extract. Betaine was also proven to be effective to halt liver diseases progression including NASH and hepatitis C virus infection through anti-inflammatory effects. Other major compounds were yielding a variety of biological activities including Hexadecanamide, Diisobutylphthalate which is commonly used as plasticizers and adhesives, 2,2,6,6-Tetramethyl-1-piperidinol (TEMPO), and NP-008993.

Conclusion: Untargeted metabolomic profiling showed many bioactive compounds contained in sea grapes Ethanolic-Soxhlet extract. The major compounds in sea grapes extract showed various therapeutic potentials. Further research such as preclinical and clinical trials is required to explore the health benefits of sea grapes extract as functional properties.

Keyword: Caulerpa racemosa, functional food, metabolomics, sea grapes , metabolites

Conflict of Interest Disclosure: There is no conflict of interest to declare

PAB(T7-157)
The effect of turmeric oil on obesity and lipid metabolism in mice fed high fat diet

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Objective: Obesity is a major risk factor of cardiovascular diseases. Obesity, along with hypertension, hyperlipidemia, and type 2 diabetes, causes so-called metabolic syndrome and accelerates atherosclerosis. Turmeric oil (TO), an essential oil derived from turmeric (*Curcuma longa*), is an attractive food material that is thought to have various physiological functions promoting our health. In this study, we examined the effect of TO on mouse obesity induced by high fat diet, and further the lipid metabolism in the mice to clarify the anti-obesity mechanism.

Methods: C57BL/6J mice were divided into (1) control group fed a high fat diet containing 40% kcal Lard and (2) TO group fed a high fat diet containing 0.5% TO. The mice were fed on the experimental diets for 4 weeks and then blood, liver and adipose tissues were collected for the biochemical analyses. C57BL/6J mice were divided into (1) control group (40% kcal Lard) and (2) 0.5% TO group. The mice were kept for 2 weeks on the experimental diets. Three days prior to termination, mice were intraperitoneally injected with 0.9% NaCl D_2O (0.035 mL/g b.w.) and drinking water was replaced with 8% D_2O water. The newly synthesized fatty acid fraction in the liver was analyzed with GC/MS for the assessment of *de novo* lipogenesis (DNL).

Results: Body weight gain was significantly suppressed in the TO group compared to the control group. Although the liver, spleen, and muscle weights were not different between the two groups, white adipose tissue weights and the triacylglycerol content in the liver were significantly reduced in the TO group. The expression level of thermogenic genes *Ucp-1* and *Cidea* in white adipose tissue tended to be increased by TO. On the other hand, the hepatic lipogenic genes, *Fasn* and *Scd1* were significantly reduced in the TO group. The DNL assessed by measuring palmitate, stearate and oleate was not influenced by TO administration.

Conclusion: TO suppress body weight gain independent with the expression of thermogenic genes and lipid metabolism.

Keyword: turmeric oil, obesity, lipid metabolism, thermogenic gene

PAB(T7-158)
Identification of gut microbiota-derived fatty acids which activate fatty acid oxidation in human intestinal organoids

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Background and objectives: Gut microbiota metabolites such as fatty acids modulate host energy and lipid metabolism. It has been recently reported that lactic acid bacteria had a unique saturation metabolism from polyunsaturated fatty acids (PUFAs) such as gamma-linolenic acid (GLA) to hydroxy- or oxo-fatty acids. Dietary intake of PUFAs has been recognized as beneficial for host energy homeostasis. However, roles of PUFA-derived metabolites produced by lactic acid bacteria in human are largely

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

unknown. Nuclear receptors (NRs) are transcription factors which are activated by lipophilic ligands and regulate energy metabolism. In this study, we explored microbiota-derived fatty acids which activate NRs and lipid metabolism in human intestinal organoids.

Methods: To identify NRs activated by microbiota-derived FAs, we performed a luciferase reporter assay. Direct bindings of FAs to NRs were analyzed using a competitive binding assay with radio isotope-labeled FAs. Human iPS cells-derived small intestinal organoids were used as human intestinal model. Gene expression was quantified by a real-time quantitative PCR. Fatty acid β-oxidation was examined by FAO Blue staining. BODIPY staining and cellular triglyceride quantification were performed to analyze triglyceride accumulation in human intestinal organoids.

Results: We found that 13(OH)GLA and 13(oxo)GLA selectively activated peroxisome proliferator-activated receptor δ (PPARδ), a nuclear fatty acid receptor. 13(OH)GLA and 13(oxo)GLA potently activated PPARδ than natural ligands such as DHA or EPA. A competitive binding assay revealed that 13(OH)GLA and 13(oxo)GLA, but not GLA, directly bound to PPARdδ. Treatment of human intestinal organoids with these FAs increased PPARδ target genes which activate fatty acid β-oxidation. Furthermore, these FAs decreased triglyceride accumulation in intestinal organoids.

Conclusions: We found that 13(OH)GLA and 13(oxo)GLA, metabolites of dietary GLA produced by lactic acid bacteria, are ligands for PPARδ. We also showed 13(OH)GLA and 13(oxo)GLA activate fatty acid β oxidation through PPARδ, and suppressed lipid accumulation in human intestinal organoids. Because excess accumulation of intestinal lipid causes several pathological effects, these FAs may contribute to alleviation and prevention of lifestyle-related diseases such as obesity.

Keyword: Gut microbiota, Lipid metabolism, Small intestine, Organoid, PPARδ

PAB(T7-159)
The absorption and metabolism of γ-oryzanol, a functional compound characteristic of rice bran, is different depending on its molecular species

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Background and objectives: γ-Oryzanol (OZ) is a bioactive compound characteristically contained in rice bran. OZ is a mixture of ferulic acid (FA) esters of phytosterols (PS) and triterpene alcohols (TTA). Despite PS- and TTA-type OZ having strikingly different chemical structures, studies on their absorption and metabolism have been mostly done using a mixture of PS- and TTA-type OZ, thus their individual absorption and metabolic profile remained unclear. Hence, in this study, we investigated the absorption and metabolism of each major OZ molecular species in rice bran (i.e., PS-type OZ; campesteryl ferulate (Camp-FA) and β-sitosteryl ferulate (Sito-FA), TTA-type OZ; 24-methylenecycloartanyl ferulate (24MCA-FA) and cycloartenyl ferulate (CA-FA)).

Methods: Camp-FA and Sito-FA were synthesized via the silyl protection of the phenolic hydroxyl group of FA, followed by their condensation with campesterol and β-sitosterol and deprotection of the silyl group. 24MCA-FA was isolated from rice bran, and CA-FA was purchased commercially. Following a single oral loading of each sample (300 μmol/kg body weight) to SD rats (male, 12-week-old), blood was collected from the tail vein (0-12 hours) and subjected to analysis using the liquid chromatography-tandem mass spectrometry system.

Results and Discussions: In the PS-type OZ group (given the Camp-FA or Sito-FA), intact OZ and its metabolites (i.e., FA and FA conjugates) were detected in plasma, and its concentrations increased over time post-dosing. Meanwhile, in the TTA-type OZ group (given the 24MCA-FA or CA-FA), plasma levels of intact OZ increased over time, but interestingly, FA and FA conjugates were hardly detected. As mentioned above, previous studies, including ours, used the mixture of OZ for the evaluation of the absorption and metabolism of OZ. Thus, the differences of the metabolic profiles of molecular species of OZ remained unknown. In this study, our results clearly showed how the absorption and metabolism of OZ differ greatly between the PS-type and TTA-type OZ, indicating that the mechanisms of physiological functions of OZ may also be completely different between PS-type and TTA-type OZ. Therefore, further elucidation of their metabolic profiles is necessary to gain better understanding of the physiological functions of OZ.

Keyword: γ-oryzanol, ferulic acid, absorption and metabolism, triterpene alcohol, phytosterol

Conflict of Interest Disclosure: The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: K. Sawada and H. Hashimoto are employee of a commercial company "Tsuno Food Industrial CO., LTD.". The company provided support in the form of remuneration for K. Sawada and H. Hashimoto, but did not have any additional role in the study.

PAB(T7-160)
Anti-inflammatory effects of δ-tocopherol on adipose tissues in rats induced inflammation by LPS administration.

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Background and objectives: It is known that obesity induces a chronic inflammatory reaction, which causes lifestyle-related diseases such as diabetes, dyslipidemia, and heart disease. Therefore, it is suggested that the inhibition of inflammation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

leads to suppressing the onset of the lifestyle-related disease. Vitamin E is a fat-soluble vitamin present in vegetable oils and nuts and has eight different naturally occurring forms. Four tocopherols (α-, β-, γ-, and δ-tocopherol) and four tocotrienols (α-, β-, γ-, and δ-tocotrienol). Among them, there are many reports on the function of α-tocopherol, but there are few reports on δ-tocopherol. In this study, we investigated about the anti-inflammatory effect of δ-tocopherol on adipose tissue in rats induced inflammation by lipopolysaccharide (LPS) administration.

Methods: We used male SD strain rats (3 weeks of old, n=25). Initially, the rats were fed a control diet (high-fat and high-sucrose diet) for 1week to allow them to adapt to the new environment. To avoid differences, the rats were then divided according to their average weight into four groups: the control (C; n=7), LPS (LPS; n=6), LPS+α-tocopherol (LPS+α; n=6), and LPS+δ-tocopherol (LPS+δ; n=6). After 4 weeks, all rats except C group were intraperitoneally administered 1 mg LPS / kg B.W. and rats of C group were administered PBS instead of LPS. After four hours, rats sacrificed under isoflurane anesthesia.

Results: Plasma glucose concentration of C group was significantly higher than that of LPS, LPS+α, and LPS+δ group. The gene expressions of TNF-α, IL-6, MCP-1 and IL-1β in perirenal fat of LPS group were remarkably higher than those of the C group. On the other hand, the gene expression of IL-1β in perirenal fat of LPS+δ group tended to decrease compared to the LPS group.

Conclusions: According to the above results, we suggested that δ-tocopherol has a potential power of anti-inflammation on adipose tissue of rats. Currently, we continue to examine about signal transduction of inflammation using adipocytes.

Keyword: vitamin E, δ-tocopherol, inflammation, obesity, adipose tissue

PAB(T7-161)
Development of Protein Bar as Supplementary Food Product for Tuberculosis (TB) Patients

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Background and objectives: Tuberculosis (TB) is a major health problem. 554 cases of TB for every 100,000 Filipinos were recorded by the World Health Organization (WHO) — the highest TB incidence rate in Asia. Drugs used for treating TB reduce appetite and cause malabsorption of essential vitamins and minerals, affecting patients with comorbidities like undernutrition, anemia, and diabetes. There is no supplementation program for TB patients and thus this study aims to develop food products to help improve their nutritional status. A protein bar is a suitable form of food appropriate for distribution at 8,541 TB diagnostic and treatment facilities nationwide. It is ready-to-eat, caloric dense, and has a long shelf life.

Methods: Energy-dense whey protein concentrate (WPC) and isolated soy protein (ISP) were used together with functional ingredients like inulin and L-glutathione. Vitamins and mineral premix added meet 40% of the average recommended energy and nutrient intake (RENI) for males 35-64 years old. The bars were processed through a cold sheeting method and packed at 40g serving size to preserve the effectiveness of vitamins and functional ingredients that have been added. The most acceptable prototype sample in terms of texture, chewability, taste, and appearance was then subjected to consumer acceptability using paired preference tests over an existing brand in the market. The results were analyzed using a two-tailed F test at 95% significance level. The prototype exceeding the required amount of agreeing judges was subjected to shelf-life and nutrient analysis.

Results: The developed protein bar has around 500 calories per serving. It contains 22 micronutrients that are 40% above the RENI of an adult. It includes functional ingredients – inulin and L-glutathione that help reduce potential toxicity to anti-TB medications and cater to TB patients who are also hyperglycemic.

Conclusions: The protein bar can be suitable supplementary food for TB patients because of its high macronutrient and micronutrient content. It is conveniently packaged and can be distributed at scale. Guidelines for nutritional care in TB recommend consuming two bars per day per person in between meals to provide 1000 calories and 44 grams of protein daily.

Keyword: protein bar, tuberculosis, functional food, ready-to-eat

PAB(T7-162)
Effect of perilla flavonoid apigenin on tryptophan-NAD metabolic key enzymes expression in LPS-stimulated microglial cells and its mechanism

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Background and objectives: Flavonoid apigenin (AP) is abundantly present in various vegetables such as perilla. AP has anti-oxidant and anti-inflammatory effects. 2-Amino-3-carboxymuconate-6-semialdehyde decarboxylase (ACMSD) and Indole amine 2,3 dioxygenase (IDO) are metabolic key enzymes that play pivotal role in tryptophan degradation via kynurenine pathway. Tryptophan is converted to various metabolites such as NAD and quinolinate (QUIN). Excess production of QUIN leads to pathogenesis of neurodegenerative diseases. ACMSD and IDO affect QUIN production. Therefore, regulation of ACMSD and IDO may be effective to suppress QUIN production and the progression of neurodegeneration. In this study, we examined the effect of AP on ACMSD and IDO expression, inflammatory mediators and related inflammatory signal pathways including NF-κB pathways in lipopolysaccharide (LPS)-stimulated microglial cells.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: The MG6 cell line, derived from mouse microglial cells was used. Cells were cultured in dishes in Dulbecco's modified Eagle's medium with fetal bovine serum. MG6 cells were treated with LPS and/or AP for the detection of ACMSD expression, nitric oxide (NO) secretion and inflammatory cytokine production. NO concentration in the medium was measured by the Griess reaction method. Subsequently, ACM*SD* and *IDO* mRNA expression levels were measured by quantitative polymerase chain reaction. Related inflammatory mediators were also measured by enzyme-linked immunosorbent assay (ELISA). Protein expression levels were detected by Western Blot analysis.

Results: LPS suppressed ACMSD and enhance IDO expression, which may lead to increase QUIN concentration. However, AP recovered LPS-stimulated ACMSD and IDO expression. Furthermore, it also inhibited interleukin-6 (IL-6) and NO production. AP also inhibited degradation of IκBα.

Conclusions: AP recovered LPS-stimulated ACMSD and IDO mRNA expression and suppressed some inflammatory mediators, which may be mediated by inhibition of the NF-κB pathway in microglial cells. These results suggest that AP may be helpful for avoiding central nerve system inflammation.

Keyword: inflammation, microglia, tryptophan, NAD, apigenin

Conflict of Interest Disclosure: The authors have no conflict of interest to declare.

PAB(T7-163)
Effect of urolithin on Japanese cedar allergic rhinitis in mice.

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Background and objectives: Urolithin (U) compounds are known to be detected in blood after ingestion of ellagic acid (EA) contained in pomegranate and berries. It has been reported that some U compounds inhibit the degranulation of the mast cell line RBL-2H3. However, the in vivo allergic inhibitory effect of U has not been clarified. In this study, we first compared the degranulation inhibitory effects of each U compound on RBL-2H3 cells. Next, we examined the possibility that Urolithin A (UA) suppresses allergic reactions in a mouse model of cedar pollinosis.

Methods: After RBL-2H3 cells were primarily sensitized with dinitrophenyl IgE, degranulation inhibition activity of UA, UB, UC, UD, UH, and EA was tested with a secondary sensitization. Twenty-one 5-week-old BALB/c female mice were intraperitoneally injected with cedar pollen antigen on days 0, 7, and 14 as primary sensitization. From day 21 to 39, cedar pollen antigen was administered intranasally as a secondary sensitization. On day 27, the mice were divided into three groups: control (C), UA, and dexamethasone (Dex) groups. From day 28 to 39, the C group was treated with pure water, the UA group with 1 mg/animal of UA, and the Dex group with 0.1 mg/animal of Dex directly by oral gavage. Sneezing frequency was measured on the 39th day. On the 40th day, autopsies were performed and serum IgE levels (ELISA) and eosinophil counts (Diff-Quik staining) in nasal lavage fluid (NALF) were measured.

Results: In vitro, UC and UH at concentrations of 1 µM or higher, and UA and UB groups at concentrations of 10 µM or higher inhibited the release of β-hexosaminidase more than EA. In vivo, compared to group C, the number of sneezes and the number of eosinophils in NALF of UA were significantly reduced to the same level as those in the Dex group. Serum IgE levels were not significantly different among the groups.

Conclusions: UA did not affect IgE concentration in blood of pollinosis model mice, but suppressed sneezing caused by pollinosis through inhibition of eosinophil migration and degranulation.

Keyword: allergic rhinitis, cedar pollinosis, ellagic acid, urolithin, RBL-2H3 cells

Conflict of Interest Disclosure: This study was funded by DAICEL CORPORATION.

PAB(T7-164)
Effect of catechol on Nrf2-mediated oxidative stress response gene.

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Purpose: Oxidative stress causes various diseases. Recent studies have shown that some food ingredients may induce oxidative stress response genes and enhance oxidative stress tolerance at the cellular level. Activation of the transcription factor Nrf2 is involved in the expression of various oxidative stress response genes. Catechol (CC) is produced from chlorogenic acid during the roasting process of coffee. It has been clarified that CC has an anti-inflammatory effect by Nrf2 intervention. In this study, we investigated the possibility that CC improves oxidative stress tolerance via Nrf2.

Method: HepG2 cells were used to evaluate the oxidative stress response. The HepG2 cells were pre-treated with CC for 6 days.CC was removed and H_2O_2 was added as an inducer of oxidative stress. Cell viability was determined by WST-1 assay. Intracellular ROS accumulation was measured using the fluorescent marker, DCFH-DA. RNA and protein were extracted from the CC-treated cells, and the expression levels of Nrf2 and oxidative stress response genes were measured. RNA was evaluated by the RT-PCR, and proteins were evaluated by Western blot.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Results: CC-treated cells increased H_2O_2-induced cell viability and significantly reduced ROS production compared to CC-untreated cells. As a result of comparing the expression of HO-1, TXNRD1, and γ-GSC of HepG2 supplemented with CC in advance, CC significantly increased the mRNA expression level and protein expression level in HepG2 cells. In addition, as a result of comparing the amount of Nrf2 in the nucleus of HepG2, the amount of Nrf2 in the nucleus increased as compared with the case where CC was not added.

Conclusion: As a result of this study, it was suggested that CC continuously induces the activation of Nrf2 in HepG2 and enhances the antioxidant action of the cells themselves via oxidative stress response genes.

Keyword: Oxidative stress, Antioxidant, pyrocatechol, Nrf2, Hepatocyte

PAB(T7-165)
Effects of urolithin A on osteoblast differentiation-related proteins.

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Background and objectives: Urolithin A is a polyphenol that is metabolized by intestinal bacteria when ellagic acid is ingested and detected in the blood. It has been reported that ingestion of ellagic acid increases the bone mineral density in postmenopausal osteoporotic mice, but the low rate of transfer into the blood after oral ingestion of ellagic acid suggests that urolithin A is likely to be the active metabolite. However, the action of urolithin A on osteoclasts has not been investigated. We found that urolithin A inhibited the differentiation of hematopoietic stem cells into osteoclasts. In this study, we sought to determine the effect of urolithin A on the phosphorylation of c-jun N-terminal kinase (JNK) and extracellular signal-regulated kinase (ERK), which are upstream of NFATc1, the master transcription factor for osteoclast differentiation.

Methods: Bone marrow fluid from the femur and tibia of ddY 8-week-old mice was collected and seeded into dishes, one day later, floating cell mouse bone marrow-derived hematopoietic stem cells were collected and seeded at 12.5 x 10^4 cells/cm^2. Macrophage colony-stimulating factor (30 ng/mL) and receptor activator of nuclear factor kappa-B ligand (50 ng/mL), which are differentiation inducers for osteoclasts, were added and cultured at the same time as the seeding. Osteoclast differentiation was assessed by tartrate-resistant acid phosphatase (TRAP) staining, mRNA expression of osteoclast differentiation-related genes by RT-PCR, and protein expression by Western blotting.

Results: TRAP staining showed that urolithin A significantly inhibited osteoclast differentiation at a concentration of 10 µM, RT-PCR showed that urolithin A suppressed NFATc1, DC-STAMP, matrix metalloproteinase 9, cathepsin K, and TRAP. Western blotting results suggested that urolithin A reduced the expression level of p-JNK.

Conclusions: These results indicate that urolithin A may inhibit osteoclast differentiation by inhibiting JNK phosphorylation followed by suppressing NFATc1 expression.

Keyword: Hematopoietic stem cells, Osteoclast, Urolithin A, Bone, Osteoporosis

PAB(T7-166)
Postbiotic of LP CBA L74 or Lactobacillus rhamnosus GG prevent gliadin induced activation of mTOR pathway and NFK-β activation in Caco-2 cells and intestinal organoids

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Background and objectives: Celiac disease (CD) is an autoimmune disease characterized by an altered immune response induced by gliadin peptides that are not digested and by damage of the intestinal mucosa. Therapy for the disease is a lifelong diet without gluten. Alternative therapies for CD have been proposed, in particular one of this is focused on the destruction of gliadin peptides present in the food, while another approach has the goal of blocking the entry of peptides in the intestinal epithelium, preventing the activation of the immune response. Probiotics and postbiotics, substances produced through the metabolic activity of the microorganism, have characteristics that could be useful in both these areas. The aim of this study was to investigate whether the postbiotic of Lactobacillus paracasei (LP) and Lactobacillus rhamnosus GG (LGG) could prevent the action of gliadin peptides on mTOR, autophagy and inflammatory response.

Methods: We treated Caco-2 cells an intestinal cell line with gliadin peptic-tryptic digested peptides (PTG), or P31-43 alone, before and after postbiotic pretreatment with LP CBA L74 (LP CBA L74) or Lactobacillus rhamnosus GG (ATCC 53103) (1x10^9). As read out of inflammation we evaluated the levels by western blot (WB) analysis of pmTOR, p70S6k, p4EBP and pNFkβ. To study autophagy, we analysed LC3 and p62 levels by WB and immunofluorescence. We confirmed these data on intestinal organoids derived from celiac (CD) patients biopsies.

Results: Levels of phosphorylation of mTOR, p70S6k and p4EBP1 were increased after treatment of PTG and P31-43 indicating that intestinal epithelial cells responded to gliadin peptides activating the mTOR pathway. Moreover, we observed an increase of phosphorylation of NFKβ and a decrease of authophagy. Pre-treatment with postbiotic LP CBA L74 or

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Lactobacillus rhamnosus GG (ATCC 53103) prevented the mTOR pathway activation, the NFKβ phosphorylation and increased the autophagy. The increase of pNFkB after gliadin peptides treatment was confirmed in intestinal organoids from CD patients also in this case the postbiotic of LP and LGG are able to prevent these effects.

Conclusions: These preclinical studies are a good basis to plan clinical trials in celiac patients to prevent the pro-inflammatory effects of gliadin peptides.

Keyword: celiac disease (cd), gliadin peptides, postbiotic of lactobacillus paracasei (lp) and lactobacillus rhamnosus gg (lgg), autophagy, intestinal organoids

Conflict of Interest Disclosure: The authors declare no conflict of interest

PAB(T7-167)
Dietary ellagic acid retards atherosclerosis through ameliorating vascular inflammation and endothelial dysfunction in apolipoprotein E knockout mice

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Background and objectives: Atherosclerosis particularly due to high circulating level of LDL is a major cause of cardiovascular diseases including myocardial infarction, heart failure, and stroke. Ellagic acid is a natural polyphenolic compound in fruits, vegetables, nuts, and wine, particularly rich in pomegranates and berries. Our previous study showed that ellagic acid exhibited anti-atherosclerotic activity *in vitro* by promoting cholesterol efflux from lipid-laden foam cells. The aim of this study is to investigate whether ellagic acid improves vascular endothelial function damaged in apoE knockout (KO) mice.

Methods: ApoE KO mice are highly susceptible to spontaneous hypercholesterolemia and atherosclerosis. In this study, apoE KO mice were fed Paigen's atherogenic diets for 10 weeks to induce severe atherosclerosis. Concurrently, ellagic acid was orally administrated to the apoE KO mice at the dose of 10 mg/kg for 10 weeks.

Results: Oral administration of ellagic acid reduced the number of eosinophils and basophils, and displayed lipid-lowering effects with a reduction of atherogenic index highly elevated by Paigen's diet in apoE KO mice. Ellagic acid diminished LDL-cholesterol highly elevated in apoE KO mice, whereas HDL-cholesterol was relatively enhanced. In addition, supplementing ellagic acid to Paigen's diet-fed mice lack of apoE gene substantially reduced plasma levels of C-reactive protein, soluble vascular cell adhesion molecule-1 (VCAM1) and interferon-γ but not of tumor necrosis factor-α, all involved in vascular inflammation. Staining with H&E and Oil red O showed that ellagic acid attenuated aortic plaque formation in apoE KO mice. Furthermore, ellagic acid diminished the expression of inflammatory biomarkers such as VCAM1, ICAM1, and p-selectin in aortic tissues, and enhanced the expression of endothelial function-related biomarkers such as nitric oxide synthase-2 and heme oxygenase-1.

Conclusions: Ellagic acid may be an athero-protective compound through alleviating vascular inflammation and ameliorating endothelial dysfunction.

Keyword: Ellagic acid, vascular inflammation, endothelial dysfunction, apoE knockout mice, atherosclerosis

Funding Sources: This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education (2021R1A6A1A03044501).

PAB(T7-168)
Attempt to Evaluate Comfort Level Using EEG Before and After Sugar Intake: Examination of EOG by Principal Component Analysis

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Background and objectives: It has been reported that sugar produces positive emotions in psychological questionnaire studies. However, some reports show no effect on mood, and others show increased depressed mood. Questionnaire surveys are not sufficient for subjective mood evaluation. Recently, electroencephalography (EEG), a simple measurement of central nervous system activity, has been used as an objective method for estimating mood. The Comfort Vector (CV) model based on the 1/f characteristics of alpha wave fluctuations in the frontal lobe is used as a mood evaluation index using EEG. In contrast, EEG is contaminated with Electrooculography (EOG). EOG-contaminated EEG makes the accuracy of the results of the CV model unstable. A method for removing EOG artifacts from EEG is proposed using principal component analysis (PCA). In this study, we propose a new CV model combined with PCA for objective and real-time evaluation of mood on sugar intake.

Methods: Two healthy young males participated in this double-blind crossover study. Experiments were conducted in the morning after a 12-hour fast. The subjects consumed fructose or placebo (sodium saccharin) with water. EEG and EOG were measured for 6 min 7 times before and every 10 minutes after intake with eyes closed at resting-state. The EEG and EOG signals were divided into 2.048-second segments, and the segments were graded based on the maximum amplitude of the EOG signals. PCA was applied to the EEG contaminated with EOG artifacts. Then, the analytical procedure for the CV model was performed.

Results: We report about the percentage of the region where the length of the vector in the second quadrant is greater than 50%. This percentage increased 20 min after intake for subject A and 10 min after intake for subject B in both intakes. Then, this

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DOI: 10.1159/000530786

percentage did not increase or decrease 40–50 min after placebo intake, whereas it increased after fructose intake.

Keyword: Alpha wave fluctuation, Comfort Vector model, Electrooculography, Principal component analysis, Sugar

Conclusions: We conclude that the CV model with PCA can show the difference in the change in comfort level depending on the type of sugar.

PAB(T7-169)
In vitro Metabolism of 5,7,3',4'-Tetramethoxyflavone by Rat Liver Microsomes

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Background and objectives: 5,7,3',4'-Tetramethoxyflavone (TMF) is one of the polymethoxyflavones that are abundant in the rhizomes of black ginger (*Kaempferol Parviflora*) and have been reported to show various biological effects such as inhibitory effect of P-glycoprotein, anti-inflammatory effect, cytotoxicity against cancer cell lines. Therefore, the metabolism of TMF was investigated using rat liver microsomes and the effects of typical cytochrome P450 (CYP) inducers, phenobarbital (PB), 3-methylcholanthrene (MC) and dexamethazone (DEX) were also examined.

Methods: TMF was incubated for 20 min at 37°C with rat liver microsomes, NADPH-generating system, $MgCl_2$ and 100 mM HEPES buffer (pH 7.4) under aerobic conditions. Rat liver microsomes were prepared from untreated, PB-treated, MC-treated and DEX-treated rats. After incubation, an ice-cold methanol was added to stop the reaction and the incubation mixture was centrifuged to remove the denatured protein. The supernatants obtained were applied to reverse phase HPLC and LC-MS for analyses of the metabolites.

Results: The liver microsomes from untreated animals metabolized TMF to one major metabolites (M2) and three minor metabolites (BM2, BM3 and M8). In untreated microsomes, M2 was mainly produced at a rate of 0.86 nmol/min/mg protein. BM2, BM3 and M8 were also produced at rates of 0.10, 0.09 and 0.03 nmol/min/mg proteins, respectively. In PB-, MC-, and DEX-treated microsomes, TMF was oxidized to give nine metabolites. PB- treatment showed an increase in M2 (about 2.8-fold that of untreated microsomes), and other metabolites (BM2, BM3 and M8) also increased 1.2-fold to 2.4-fold. MC-treatment decreased M2 to 60% of untreated micosomes, while five other metabolites (M1, M4, BM1, BM2 and BM3) significantly increased. DEX-treatment significantly increased M1, M3, M8, BM2 and BM3. As a result of LC-MS, eleven metabolites were determined to be a hydroxy (OH)-TMF (M3), three mono-demethylated TMF (BM3, M2, M5), four di-demethylated TMF (BM1, BM2, M6, M8), two OH・mono-demethylated TMF (M1, M7) and a OH・di-demethylated TMF (M4).

Conclusions: These results suggested that MC- and DEX-induced CYP, CYP1A and CYP3A enzymes, are important in TMF metabolism.

Keyword: Polymethoxyflavone, Tetramethoxyflavone, Metabolism, Rat, Liver

PAB(T7-170)
Antioxidant effect of yellow Chinese chives extract via elevation of the intracellular glutathione levels

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Background and objectives : Oxidative stress is pivotal in any pathological processes and reducing the level of oxidative stress is implicated in prevention of diseases such as diabetes and cancer. Glutathione, the most abundant intracellular antioxidant, protects cells against reactive oxygen species induced oxidative stress. We previously demonstrated that yellow Chinese chives (*ki-nira*) increased the intracellular glutathione levels. This study aimed to investigate the protective effects of yellow Chinese chives on H_2O_2-induced oxidative stress in human hepatoblastoma cell line HepG2 and identify a compound that increases intracellular glutathione levels.

Methods: Yellow Chinese chives were minced in a food processor and extracted with 50% aqueous ethanol for 1 h. The liquid phase was evaporated and lyophilized to obtain a yellow Chinese chive extract (YCE). HepG2 cells were cultured with or without YCE and collected on indicated times to determine intracellular glutathione levels. We also evaluated the protective effect of YCE on H_2O_2-induced cytotoxicity in HepG2 cells using MTT assay.

Results: The treatment with YCE increased the intracellular glutathione levels in a dose- and time-dependent manner. Moreover, pretreatment of cells with YCE reduced the cytotoxicity caused by H_2O_2 in a dose-dependent manner. Nuclear factor erythroid 2-related factor 2 (Nrf2) and its downstream antioxidant enzymes are considered to protect cells against oxidative stress. Therefore, we investigated the expression of Nrf2 and its target antioxidant enzyme. YCE led to an increased expression of antioxidant enzymes, cystine uptake transporter, especially hemeoxygenase-1. YCE promoted Nrf2 nuclear translocation after 3 h. In order to determine the active component, purification of the active compounds using a Sep-Pak C18 cartridge and reversed-phase HPLC, led to the identification of (Z)-10-devinylajoene (Z)-4,5,9-trithiadeca-1,6-diene 9-oxide). In addtion, knockdown of Nrf2 inhibited the increase of the intracellular glutathione levels by (Z)-10-devinylajoene.

Conclusions: These results indicate that YCE exerts a protective effect against oxidative stress by modulating glutathione levels and anti-oxidative enzyme expression *via* the Nrf2 pathway. We identified (Z)-10-devinylajoene as a

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

compound that increases intracellular glutathione levels from the yellow Chinese chives.

Keyword: yellow Chinese chives, glutathione, nuclear factor erythroid 2-related factor 2 (Nrf2)

PAB(T7-171)
Niclosamide activates the AMP-activated protein kinase complexe containing β2 subunits independently of AMP sensitivity

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Background and objectives: AMP-activated protein kinase (AMPK) is a major regulator of cellular energy homeostasis. AMPK is a highly conserved serine/threonine kinase, composed of a catalytic α subunit and β and γ regulatory subunits. Each AMPK subunit has multiple isoforms (α1/α2, β1/β2, γ1/γ2/γ3), which can be combined to form multiple heterotrimeric complexes. For the AMPK activation, phosphorylation of Thr172 of the α catalytic subunit is essential. Furthermore, increased cellular AMP and ADP induce allosteric activation of AMPK by binding to the γ subunit and preventing dephosphorylation of Thr172. Activated AMPK phosphorylates many substrates and promotes catabolic processes to maintain cellular ATP concentrations while inhibiting anabolic processes. Thus, AMPK activators are important therapeutic targets for metabolic syndrome. In recent studies, niclosamide (5-chloro-salicyl-(2-chloro-4-nitro)anilide), an FDA-approved anthelmintic, improved blood glucose levels in mice via AMPK activation and niclosamide is thought to activate AMPK by increasing the AMP/ATP ratio through mitochondrial uncoupling. However, the details of its action remain unclear. The purpose of this study is to determine how niclosamide activates AMPK and whether the activation occurs in an AMP-independent manner.

Methods: To evaluate niclosamide for the activity of AMPK in cultured cells, we treated HEK293T cells with niclosamide and measured phosphorylation of Thr172 on the AMPK α subunit and phosphorylation of ACC. To examine the effect of niclosamide on AMP-insensitive AMPK complex, HEK293T cells were expressed with AMPK γ subunit mutant (D90A).

Results: We found that niclosamide also activates AMPK complexes containing AMP-insensitive γ subunits. We further examined AMPK activation by niclosamide in combination with α1/α2 and β1/β2 subunits and found that the β2-containing AMPK complex is activated. This effect was suppressed by replacing the Ser108 residue in the β2 subunit with alanine.

Conclusions: Niclosamide has a novel AMP-independent AMPK activation mechanism. In addition, unlike A-769662, a direct AMPK activator, niclosamide specifically activates AMPK via the AMPK β2 subunit. In skeletal muscle, exercise specifically activates the AMPK α2β2γ3 complex and improves metabolism via phosphorylation of AMPK substrates. Therefore, niclosamide may be effective as an AMPK activator targeting skeletal muscle.

Keyword: AMPK, Niclosamide, Diabetes

PAB(T7-172)
Infant curcumin intake enhances antioxidant by upregulating Nrf2 in the kidneys of fructose-loaded female pups exposed to undernutrition during fetal and infancy

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Background and objectives: Excessive intake of fructose induces oxidative stress in the kidney. Moreover, excess fructose suppresses the expression of NF-E2-related factor 2 (Nrf2), a transcription factor involved in antioxidant regulation. Curcumin plays a role in activating Nrf2 in the kidney, increasing heme oxygenase-1 (HO-1) and superoxide dismutase (SOD) expression levels, and alleviating oxidative stress. However, little is known regarding the effects of infancy curcumin intake. We investigated whether infancy curcumin intake upregulates Nrf2 and suppresses oxidative stress in the kidney due to fructose-loading.

Methods: Pregnant Wistar rats received diets containing 20% (NP) or 8% (LP) casein, in addition to 0% or 0.25% curcumin (Cur)-containing LP diets (LP/LP and LP/Cur) during lactation. At weaning, the pups were fed distilled water (W) or 10% fructose solution (Fr) and accordingly divided into four groups: NP/NP/W, LP/LP/W, LP/LP/Fr, and LP/Cur/Fr. Body weight and food and water intake were measured during breeding. At 13 weeks, glucose (Glc), triglyceride (TG), urea nitrogen (BUN), creatinine (Cr), and malondialdehyde (MDA) levels in the plasma and protein expression of Nrf2, HO-1, superoxide dismutase 1 (SOD1), and superoxide dismutase 2 (SOD2); glutathione (GSH) level; and glutathione peroxidase (GPx) activity in the kidney of female pups were examined.

Results: No significant difference was found in body weight between the LP/LP/Fr and LP/Cur/Fr groups at 13 weeks of age. At 12 weeks of age, food and water intake of the LP/LP/Fr and LP/Cur/Fr groups decreased significantly compared to that of the NP/NP/W and LP/LP/W groups, respectively. Glc, TG, and MDA levels in the plasma were significantly lower in the LP/Cur/Fr than in the LP/LP/Fr group; however, BUN and Cr were not significantly different between the groups. Nrf2, HO-1, and SOD1 protein expression; GSH levels; and GPx activity in the kidney were significantly higher in the LP/Cur/Fr than in the LP/LP/Fr group.

Conclusions: Infant curcumin intake may upregulate Nrf2 in the kidney, enhance antioxidant regulation, and suppress oxidative stress due to fructose-loading.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-173)

Gut microbial short-chain fatty acids-mediated olfactory receptor 78 stimulation promotes anorexigenic gut hormone peptide YY secretion in mice

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Background and objectives: Olfactory receptor 78 (Olfr78), which is also known as a receptor for short-chain fatty acids (SCFAs) produced via gut microbial fermentation from indigestible polysaccharides such as dietary fibers, is expressed in the enteroendocrine cells of the colon. However, the role of Olfr78 in gut hormone secretion remains unknown. Here, we aimed to investigate the function and mechanism of action of Olfr78 in vivo and in vitro.

Methods: We assessed the expression of Olfr78 in several tissues, affinity of Olfr78 to various monocarboxylates, and the secretion of anorexigenic gut hormone peptide YY (PYY) via Olfr78 using various molecular and biochemical techniques.

Results: Olfr78 was abundantly expressed in the colon and mouse enteroendocrine cell line STC-1 and showed specific affinity to SCFAs such as acetate and propionate, but not butyrate, in a monocarboxylate ligand screening assay using a heterologous expression system. Acetate promoted PYY secretion in STC-1 cells via Olfr78-protein kinase A signaling, whereas the effects were abolished by Olfr78 RNA interference. Colonic SCFAs production via oral administration of fructo-oligosaccharide significantly increased plasma PYY levels, whereas this effect was abolished in Olfr78-deficient and germ-free mice.

Conclusions: These results suggested that the SCFA receptor Olfr78 is important for anti-obesity and anorexigenic effects of the gut microbiota and dietary fibers (Nishida et al. *Biochem Biophys Res Commun*. 2021).

Keyword: SCFAs, Olfr78, gut microbiota, PYY, GPCRs

PAB(T7-174)

Curdlan intake changes gut microbial composition, short-chain fatty acid production, and bile acid transformation in mice

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Background and objectives: Indigestible polysaccharides, such as dietary fibers, benefit the host by improving the intestinal environment. Short-chain fatty acids (SCFAs) produced by gut microbial fermentation from dietary fibers exert various physiological effects. The bacterial polysaccharide curdlan benefits the host intestinal environment, although its effect on energy metabolism and SCFA production remains unclear. Hence, this study aimed to elucidate the effect of curdlan intake on gut microbial profiles, SCFA production, and energy metabolism in a high-fat diet (HFD)-induced obese mouse model.

Methods: We first assessed changes in gut microbial composition, SCFA production, and glucose homeostasis following curdlan supplementation in HFD-fed mice. Additionally, we examined the fecal primary and secondary BAs to clarify the relationship between curdlan intake and plasma GLP-1 increase in addition to SCFA.

Results: Gut microbial composition of fecal samples from curdlan-supplemented HFD-fed mice indicated an elevated abundance of Bacteroidetes, whereas a reduced abundance of Firmicutes was noted at the phylum level compared with that in cellulose-supplemented HFD-fed mice. Moreover, curdlan supplementation resulted in an abundance of the family Bacteroidales S24-7 and Erysipelotrichaceae, and a reduction in Deferribacteres in the feces. Furthermore, curdlan supplementation elevated fecal SCFA levels, particularly butyrate. Although body weight and fat mass were not affected by curdlan supplementation in HFD-induced obese mice, HFD-induced hyperglycemia was significantly suppressed with an increase in plasma insulin and incretin GLP-1 levels.

Conclusions: Curdlan supplementation elevated fecal bile acid and SCFA production, improved host metabolic functions by altering the gut microbial composition in mice [Watanabe and Yamano (co-1st author) et al. *Biochem Biophys* Rep. 2021].

Keyword: Curdlan, Dietary fiber, SCFA, short-chain fatty acids, Intestinal environment

PAB(T7-175)

Phytochemical Screening of Local Lombok Island *Moringa Oleifera Leaf* Powder as Diabetes Therapy Through IRS-1- Expression Regulation

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Background and objectives: Moringa *(Moringa oleifera*) is a plant that can grow regardless of the season, so it is easy to obtain, relatively inexpensive, and can thrive in almost all parts of Indonesia, including Lombok Island, West Nusa Tenggara province. *Moringa oleifera* leaves are sources of polyphenolic compounds such as flavonoids and phenolic acids, that can function as antidiabetics. This study aims to identify the chemical compounds contained in *Moringa oleifera* from Lombok Island and predict its role as a therapy for diabetes mellitus.

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DOI: 10.1159/000530786

Methods: Phytochemical screening was conducted using the predict spectrophotometric method, while the amino acid analysis was done using the UPLC method. In silico was performed to predict the compound contents in *Moringa oleifera* and to describe its role in certain biological processes.

Results: Analysis of Pa (probability "to be active") using the Pass Server approach predicted that *Moringa oleifera* could be used for diabetes treatment (Pa values of 0.387 and 0.446), since it has significant role as anti-inflammatory (Pa value of 0.707) and antioxidant (Pa value of 0.839). Analysis by using the STITCH program showed that quercetin is one of the flavonoids found in *Moringa* leaves that effect the expression regulation of IRS-1. The phytochemical screening results show that *Moringa oleifera leaf* powder from Lombok Island contained polyphenols, flavonoids, tannins and quercetin, in where polyphenols is the most compound contained (864.09 mgGAE/100 g). Of 15 kinds of amino acids in *Moringa oleifera* powder, the highest number of amino acids is L-Glutamic Acid (22012.14 mg/kg).

Conclusions: *Moringa oleifera* leaf powder from Lombok Island contains polyphenols, flavonoids, tannins ,quercetin, and amino acids. Quercetin is predicted to have the ability as a diabetes therapy by regulating the expression of IRS-1.

Keyword: Moringa oleifera, phytochemical screening, in silico, diabetes mellitus.

PAB(T7-176)
Anti-proliferation effect of *S*-allyl-L-cysteine sulfoxide in garlic against cutaneous tumor, melanoma

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Background and objectives: Melanoma is a malignant tumor in the skin, causing 55,000 deaths annually around the globe. Because few treatment options have been available, melanoma is a life-threatening disease once it spreads. Therefore, it is required to prevent the proliferation of melanoma cells in the early stage. Garlic is known as an anti-cancer food. The major effective components are reported to be lipophilic sulfides such as diallyl trisulfide, and diallyl disulfide which are enzymatically produced from S-allyl-L-cysteine sulfoxide (ACSO) when garlic is cut or crushed. However, having strong garlic odor, these sulfides are difficult to be applied as food ingredients. On the other hand, ACSO, a garlic-odor precursor, is odorless, highly water-soluble, and enhances good tastes. We have already found that ACSO possesses various pharmacological effects such as anti-platelet aggregation and hepatoprotective effects *in vivo*. Here, we investigated if ACSO would suppress the proliferation of melanoma cells.

Methods: ACSO was orally administered to C57BL/6J mice after subcutaneous injection of mouse melanoma B16F1 cells. Then, tumor volume and LDH activity in the blood, an indicator of melanoma progress, were measured. Anti-proliferation effect of ACSO was also investigated using B16F1 melanoma cells and normal NHEM melanocytes. ACSO was added to these cells and then the cell viabilities were measured using MTT assay.

Results: Orally administered ACSO significantly suppressed tumor growth of melanoma and the increased in LDH activity compared with those of mice administered distilled water as a vehicle. In addition, ACSO decreased cell viability of melanoma cells, but did not affect that of melanocytes.

Conclusions: Considering that ACSO is reported to be absorbed from the small intestine to the blood, our results indicate that orally administered ACSO was delivered to the skin tumor and suppressed the proliferation of melanoma cells without affecting normal melanocytes. ACSO has the potential to be used as a food material to prevent melanoma proliferation.

Keyword: Garlic, Melanoma, Alliin

PAB(T7-177)
Intake of soymilk-okara powder for 12 weeks decreases body fat and increases body muscle in Japanese adults: A single-arm intervention study

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Background and objectives: Okara is a by-product of soymilk manufacturing and a rich source of protein and dietary fiber. Some animal model reports suggested that okara intake might increase lipid catabolism and decrease anabolism. Moreover, in a mouse model experiment diets supplemented with okara altered cecal microbiota. However, there are few reports of dietary okara intake for the long term in healthy humans. This study investigated whether dietary okara intake in the long term affects the body composition and the gut microbiota flora in healthy Japanese adults.

Methods: 46 participants (women: 43) were enrolled. All the subjects ingested 15g of okara powder (Soymilk-okara powder, Kikkoman Soyfoods Company, Japan) every day for 12 weeks. The subjects' body composition was assessed per 4 weeks. At baseline and after intervention for 12 weeks, fecal microbiota percentages were measured (Techno Suruga Laboratory Co., Ltd., Japan).

Results: The median total soymilk-okara powder intake during the intervention for 12 weeks was 1182g. All the subjects ingested more than 720g (15 g/day×4 days/week×12 weeks). There was no difference in nutritional intakes and exercise habits before and after the intervention. The weight of body muscle significantly increased, and the percentage of body fat significantly decreased at 4, 8, and 12 weeks after the intervention than at baseline. The percentages of *Coriobacteriaceae, Lactobacillales, Clostridium cluster IV* and *Clostridium cluster XI* in feces significantly decreased at 12 weeks after the intervention than at the baseline. Conversely, the

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DOI: 10.1159/000530786

percentages of *Bacteroides* in feces significantly increased at 12 weeks after the intervention than at the baseline. Therefore, the *Firmicutes* group / *Bacteroidetes* group ratio in feces significantly decreased at 12 weeks after the intervention than at the baseline.

Conclusions: A dietary intake of 15g of soymilk-okara powder for 12 weeks induced a decrease in body fat, an increase in body muscle, and a change in fecal microbiota flora.

Keyword: Okara, Body muscle, Body fat, Microbiota flora, Human

Conflict of Interest Disclosure: Masahiro Katsukawa and Yaeko Hayase are employees of Kikkoman Food Products Company. This work was supported by the Kikkoman Food Products Company.

PAB(T7-178)
Metabolite profiling and antioxidant activity of early immature durian (*Durio zibethinus* L.) fruit

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Background and objectives: Early immature durian (*Durio zibethinus* L.) fruit (30-45 days after anthesis with 6-12 cm in length) is currently considered as an agricultural waste from durian cultivation. This is because the fruit at this stage in large quantity are pruned out to preserve the quality (taste and size) of the fruit left on the trees. Therefore, the aim of the present study was to investigate the metabolite profile of early immature durian fruit.

Methods: GC-MS and HPLC-Q-TOF-MS/MS procedures were used to perform metabolite profiling of early the immature durian fruit. In addition, HPLC analysis was used to quantitively analyzed major bioactive compounds. DPPH and FRAP assays were prepared to evaluate antioxidant activity of the extract.

Results: Four groups of primary metabolites (sugars, organic acids, amino acids, and miscellaneous) were annotated using GC-MS, meanwhile HPLC-Q-TOF-MS/MS analysis revealed a few dominant secondary metabolites. Subsequently, we quantitively analyzed procyanidin B2, procyanidin C1 and (-)-epicatechin using HPLC and suggested them as major bioactive compounds. Moreover, the results of DPPH and FRAP assays showed that the extract had a greater antioxidant activity than ascorbic acid.

Conclusion: These results point out several aspects that the early immature durian fruit can be potentially exploited as an accessible source of bioactive ingredients with strong antioxidants for foods, cosmetics, or pharmaceutical industries.

Keyword: durian, antioxidant activity, metabolite profiling, bioactive compound

PAB(T7-179)
Investigation of mannooligosaccharides from coffee administration and synergistic effect with vitamin D3 on calcium absorption in rats

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Background and objectives: We confirmed that mannooligosaccharides (MOS) derived from coffee have promotive effects on calcium absorption in the large intestine, and short-chain fatty acids (SCFA) in the large intestine are thought to be the cause of these effects. Vitamin D3 (VD3), on the contrary, is known to aid calcium absorption in the small intestine, and the Japanese government has approved it for use in nutritionally functional meals. The synergistic effects of MOS and VD3 on calcium absorption in Sprague–Dawley (SD) rats were examined in this study.

Methods: This study was carried out with the approval of the Ethics Committee of Ajinomoto General Foods, INC. For 14 days, SD rats (5 weeks old) were fed the control diet (CFR-1; CLEA Japan INC.) and water *ad libituim*. During the experimental period, MOS (200 mg/kg body weight) or VD3 (2 µg/kg body weight) or both MOS and VD3 were orally administered to the rats daily. The SD rats were given a calcium solution (500 mg/kg body weight) on the 14th day, 15 min after each item was given, and urine was collected for 12 h. The calcium content of the urine was determined.

Results: MOS or VD3 administration resulted in a substantial increase in urine calcium when compared to the control ($p < 0.05$ in both). In comparison to the control, MOS + VD3 treatment resulted in a significant increase. However, there was no statistically significant difference in MOS + VD3 administration and MOS or VD3 administration.

Conclusions: In this study, MOS administration had enough effects on calcium absorption. However, the synergistic effects of VD3 and MOS were not confirmed in this study.

Keyword: Mannooligosaccharides, Vitamin D3, Calcium absorption

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-180)
Establishment of a culture-based porcine intestinal microbiota model (TUSIMM: Tohoku University Swine Intestinal Microbiota Model)

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Background and objectives: The effects of dietary components on the gut microbiota are examined through human intervention studies. However, these investigations are difficult to execute due to their high expenses and ethical considerations. As a result, porcine is employed as a substitute model, but for the same reasons, its usage should be limited. Up to date, only a few semi-continuous or continuous in vitro models have been constructed, which are sophisticated and do not accurately recreate the fecal microbiota. Therefore, the objective of this study was to establish an optimal model system for porcine by seeking a culture medium that can reproduce the porcine fecal flora with high accuracy in a simple batch model.

Methods: Semi-fluid general anaerobic medium (GAM) or GAM supplemented with 0.5 g/L glucose (GAM+G) was distributed into vials and converted to anaerobic conditions by using a combination of N_2, CO_2, and H_2 gas. Each of the three porcine fecal samples was diluted with lyophilized anaerobic bacteria protectant and incubated for 30 hours at 37 °C. Bacterial flora analysis was then performed by using next-generation sequencing and real-time PCR for 16S rRNA genes in feces and culture medium. In addition, the concentration of short-chain fatty acids was also determined by using high-performance liquid chromatography (HPLC).

Results: Real-time PCR suggested that the culture in GAM tended to have lower numbers of Clostridium leptum subgroup and Prevotella and higher numbers of Enterobacteriaceae than fecal samples as compared with the cultures in GAM+G. The principal component analysis (PCA) by next-generation sequencing showed that the culture in GAM+G was plotted closer to fecal samples than the culture in GAM. Furthermore, the HPLC suggested that the short chain fatty acids concentration in the culture in GAM+G was closer to fecal samples than the culture in GAM.

Conclusion: It has been demonstrated that batch culture of pig feces in GAM+G employing vials is capable of reproducing the swine fecal flora to a significant extent. We are also investigating other medium to more closely mimic the porcine fecal flora, as well as culturing in an anaerobic chamber to build a more straightforward culture model

Keyword: Microbiota, Pig, Culture model, In vitro, TUSIMM

Further Collaborators: Livestock Promotional Subsidy from the Japan Racing Association

PAB(T7-181)
Protective effects of rice peptide against oxidative injury through activation of Nrf2 signaling pathway

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Background and objectives: Maintenance of balance between cellular ROS generation and antioxidant defense mechanisms is important for normal cellular function. Glutathione is the most abundant non-protein thiol antioxidant, which contributes to the maintenance of cellular redox balance. We previously showed that commercially available Oryza Peptide-P60 derived from rice increased the intracellular glutathione levels. This study aimed to evaluate the antioxidant potential of this peptide and assess its mechanism of action.

Methods: The commercial rice peptide Oryza Peptide-P60 was a gift from Oryza Oil and Fat Chemical Co., Ltd.HepG2 cells were incubated with and without Oryza Peptide-P60 (5 mg/mL). Further, intracellular glutathione levels were measured, and protein and mRNA levels of antioxidant enzymes were quantified. The concentrations of reduced and oxidized glutathione were determined simultaneously by HPLC with fluorescence detection. Relative mRNA levels were estimated using quantitative RT-PCR. HepG2 cells were treated with and without Oryza Peptide-P60 followed by exposure H_2O_2 or acetaminophen (APAP), and then cytotoxicity was evaluated by lactate dehydrogenase activity released from damaged cells in the culture medium.

Results: Pretreatment of HepG2 cells with Oryza Peptide-P60 reduced the cytotoxicity caused by H_2O_2 or APAP (ca. 48% and ca. 12% of the cytotoxicity in Oryza Peptide-P60 pretreated group compared with H_2O_2 - or APAP- treated groups, respectively) through the restoration of glutathione homeostasis. Moreover, Oryza Peptide-P60 elevated the mRNA level of γ-glutamylcysteine synthetase, which is the rate-limiting enzyme in glutathione synthesis, by ca. 3-fold at 8 h, and also increased the level of mRNAs encoding other antioxidant enzymes. Furthermore, Oryza Peptide-P60 promoted nuclear factor erythroid 2-related factor (Nrf2) synthesis, a crucial regulator for antioxidant enzymes, nuclear translocation by ca. 2-fold after 8 h. Conversely, knockdown of Nrf2 inhibited the increase in the intracellular glutathione levels and suppressed the induction of antioxidant enzymes expression by Oryza Peptide-P60.

Conclusions: Oryza Peptide-P60 induced the synthesis of glutathione and antioxidant enzymes through activation of the Nrf2 pathway, leading to the suppression of oxidative stress-induced cytotoxicity in HepG2 cells. This study suggested that Oryza Peptide-P60 contained crucial peptides with substantial antioxidant activities.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-182)
Influence of daily supplementation of royal jelly on skeletal muscle force, fatigue and training effect

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Background and objectives: Royal jelly (RJ), a natural secretion of worker honey bee, has been used as a health food. RJ is thought to improve skeletal muscle response to exercise. In this study, we examined the effects of daily RJ supplementation on skeletal muscle performance and training effects.

Methods: Nine-weeks-old male rats were assigned to control and RJ groups, and rats in RJ group were given 500 mg/kg/day RJ for 4 weeks. In either group, planta flexor muscles of left legs were subjected to endurance training and the muscles of right legs were used as untrained muscle. Under anesthesia, left leg of rat was attached to foot holder connected to force transducer. Contractions of planta flexor muscles were elicited by electrical stimulation and the force produced by these muscles were measured *in vivo*. Using this experimental system, muscles of left legs were repeatedly contracted every 5 sec for 60 min at 3 days/week for 4 weeks (endurance training). Two days after the end of training, force and fatiguability were measured in right (untrained) and left (trained) legs. Two days after the measurements, gastrocnemius (GAS) muscle, a major contributor of force production, was excised and used for analyses of citrate synthase activity and glycogen content. The data sets were statistically tested by two-way ANOVA for repeated measure and Holm-Sidak post-hoc test was subsequently used.

Results: RJ supplementation increased the force at 100 Hz but not at 20 Hz regardless training. The fatiguability was improved by endurance training but RJ supplementation exerts no effect on this improvement. Citrate synthase activity was increased by endurance training and post-hoc test indicated the significant difference between untrained and trained muscles only in RJ group. Muscle glycogen content was increased by endurance training.

Conclusions: Daily RJ supplementation 1) increases maximal force and 2) probably enhances mitochondrial biogenesis but the extent is too little to improve fatiguability.

Keyword: Royal Jelly, in vivo, force-frequency relationship, muscle glycogen, mitochondria

Conflict of Interest Disclosure: This study was funded by Morikawa Kenkodo Co. Ltd. Royal jelly used in this study was provided by Morikawa Kenkodo Co. Ltd.

PAB(T7-183)
Effect of Dietary Tamogitake (Pleurotus cornucopiae) on Lipid and Glucose Metabolisms in Rats and Mice

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Background and objectives: Tamogitake (Oyster mushroom) is an edible mushroom, which contains ergothioneine, a sulfur-containing amino acid, and has been used as a functional food for its potent antioxidant activity. In this study, we investigated the effects of dietary Tamogitake and ergothioneine on lipid and glucose metabolisms in animal models.

Methods: In experiment 1, four-week-old male Sprague-Dawley rats were fed AIN-76 based diets containing 5% Tamogitake dried-powder supplemented with or without 0.5% cholesterol for 4 weeks. In experiment 2, 4-week-old male C57BL/6J mice were fed the same diets containing 5% Tamogitake or 0.05% ergothioneine with 0.5% cholesterol for 4 weeks. Lipid and glucose parameters were measured, and quantitative real-time RT-PCR was performed for hepatic gene expression levels of HMG-CoA reductase and cholesterol 7a-hydroxylase, the rate-limiting enzymes in cholesterol synthesis and bile acid synthesis, respectively. In experiment 2, fecal lipid excretion was also measured.

Results: In experiment 1, administration of 5% Tamogitake had no adverse effects on food intake or growth; however, relative liver weights were significantly decreased in rats fed diets containing Tamogitake with or without dietary cholesterol. Serum and hepatic cholesterol and hepatic triglyceride levels were also reduced by Tamogitake feeding. No apparent effects of dietary Tamogitake on hepatic mRNA abundances of HMG-CoA reductase and cholesterol 7 a-hydroxylase were observed. Serum insulin level was significantly elevated by dietary cholesterol, while it was significantly lowered, with or without cholesterol, by dietary Tamogitake. On the hand, serum glucose concentration remained unchanged in these dietary conditions. In experiment 2, lowering effect of dietary Tamogitake on hepatic cholesterol was reproduced, but this effect was not observed in mice fed the ergothioneine-containing diet. Dietary Tamogitake and ergothioneine did not affect hepatic triglyceride level. The fecal excretions of bile acid and free fatty acid were remained unchanged by dietary Tamogitake and ergothioneine. Serum insulin level was decreased 48% by dietary Tamogitake and 72% by dietary ergothioneine.

Conclusions: These results suggested that Tamogitake has a beneficial effect on lipid and glucose metabolisms in animal model, and the lipid-lowering effects of Tamogitake might not be attributed to the ergothioneine.

Keyword: Tamogitake (Golden Oyster Mushroom), lipid metabolism, ergothioneine, rats, mice

PAB(T7-184)
Comparing the effects of cecal fermentation characteristics of raw and autoclaved-frozen white sorghum in rats

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Objective: Sorghum *Sorghum bicolor* L.) is a cereal rich in native resistant starch (RS). Similar to dietary fiber, RS also reaches the colon, where it is fermented by colonic microbiota, yielding short-chain fatty acid (SCFA). Among the five types of RS designated by the differences in physical and chemical properties, most raw starches are considered to be of RS type 1 and type 2. Generally, starches in cereals are consumed after a thermal treatment that enhances the digestibility. In the contrary, several recurrent cooking-cooling cycles are known to improve the RS content through the formation of retrograded starch (RS type 3). On the other hand, thermal cooking of sorghum has also shown to decrease the protein digestibility. Based on these grounds, this study aimed to assess the biochemical aspects of cecal fermentation of native and acclaimed RS in white sorghum in rats.

Methods: White sorghum grains were subjected to cooking (grains: water=1:2 (w/v)) by autoclaving (121℃, 20 min) and then freeze-dried. RS content in each sorghum sample was as follows (g/100 g sample): raw white sorghum (RAW), 11.6; white sorghum after one autoclave-freeze cycle (AC1), 3.64; white sorghum after three autoclave-freeze cycles (AC3), 5.81. Male Fischer 344 rats (7-week-old) were fed one of the four experimental diets (control (CON); 30% (w/w) RAW; 30% AC1, and 30% AC3; AIN-93G diet guidelines) for 4 weeks. Cecum was excised on the final day of the feeding period.

Results: Cecal pH in the AC1 and AC3 groups was lower than the CON and RAW groups. Cecal acetate, n-butyrate, and total SCFA concentrations were higher in the RAW, AC1, and AC3 groups, compared to the CON group. Further, the cecal n-butyrate concentration in the AC1 group was higher than the RAW group, while the molar proportion of n-butyrate was higher in the AC1 and AC3 groups compared to the CON and RAW groups. Cecal lactate concentration was higher in the AC1 and AC3 groups than the CON group, and was positively correlated with cecal IgA levels.

Conclusions: Autoclaved-frozen white sorghum exhibited better cecal fermentation characteristics, when compared with the raw white sorghum. On the other hand, the fermentation characteristics of AC1 and AC3 were comparable.

Keyword: sorghum, autoclaving, resistant starch, n-butyrate

Conflict of Interest Disclosure: This study received financial research support from U.S. Grains Council (Tokyo, Japan)

PAB(T7-185)
Water in oil emulsion system modifies absorption profile of green tea catechins in the body and also masks their bitter taste: Evaluation in human subjects

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Background and Objectives: Catechins are the type of flavonoids present in green tea leaves and are known to have some physiological effects such as antioxidant and anticancer activities. On the other hand, their rapid excretion from the human body and the strong bitter taste are challenges for the effective use of catechins. To overcome these challenges, we attempted to use the water in oil (W/O) emulsion system for catechins, as this has been thought to be associated with the excretion rate and the masking tastes of compounds. Therefore, this study was aimed to evaluate the ability of the W/O emulsion system in moderating the rapid excretion of catechins and masking their bitter taste in humans.

Methods: Catechins in W/O emulsion (W/O-catechin) consists of green tea extract (mainly (−)-epigallocatechin gallate, EGCG), soybean oil, and surfactant. Water-dispersed catechins (W-catechin) were prepared by dissolving the green tea extract in water. In a crossover trial with a one-week washout period, healthy volunteers (n = 12) were given ten grams of either W/O-catechin or W-catechin. Blood samples were collected at 0, 1, 3, 6, 8, 12, and 24 hours after sample ingestion, and plasma catechin levels were measured using the liquid chromatography-tandem mass spectrometry (LC-MS/MS). Each subject also rated sample's bitterness using the Visual Analog Scales (VAS).

Results: From the results of LC-MS/MS analysis, the peak of EGCG was clearly detected not only in W-catechin group but also in W/O-catechin group. Interestingly, the area under the curve of plasma EGCG levels were relatively similar in subjects given W/O-catechin and W-catechin, moreover, EGCG was absorbed more gradually and remained for a longer time in the bloodstream when delivered using W/O emulsion system. Based on the VAS results, the bitterness of the catechin was also reduced in W/O-catechin. Overall, our results demonstrated the benefits of using the W/O emulsion system to extend the residence time of catechins in the body and mask its bitterness, allowing its widespread application for therapeutic purposes in the future.

Keyword: tea catechins, W/O emulsion, absorption, bitter taste masking

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-186)

The impact of fish oil and/or probiotics intervention on vaginal microbiota in overweight and obese pregnant women

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Background and objectives: Obesity may cause perturbations in vaginal microbiota and thereby increases the risk for adverse pregnancy outcomes. The objective was to investigate the impact of long-chain polyunsaturated fatty acids (LC-PUFA, fish oil) and/or probiotics on the vaginal microbiota in overweight and obese pregnant women.

Methods: Overweight and obese pregnant women were randomly allocated into four intervention groups to consume capsules of fish oil and/or probiotics (fish oil+placebo, probiotics+placebo, fish oil+probiotics and placebo+placebo) from early pregnancy onwards. The fish oil capsules consisted of 2.4 g of n-3 LC-PUFAs (1.9 g docosahexaenoic acid and 0.22 g eicosapentaenoic acid), and probiotics capsules *Lacticaseibacillus rhamnosus* HN001 (formerly *Lactobacillus rhamnosus* HN001) and *Bifidobacterium animalis* ssp. *lactis* 420, 10^{10} colony-forming units each. Vaginal samples were collected at early (n=112) and late pregnancy (n=116) and were analysed for vaginal microbiota using 16S rRNA gene amplicon sequencing.

Results: When the active groups were compared to the placebo group, there was a lower abundance of potential pathobionts, namely *Ureaplasma urealyticum* in the fish oil group, *Ureaplasma*, *U. urealyticum* and *Prevotella disiens* in the probiotics group, *Dialister invisus* and *Prevotella timonensis* in the combination, i.e. fish oil+probiotics, group. α-Diversity did not differ between the groups at late pregnancy but it increased in fish oil group during pregnancy, whilst no difference was observed in the other groups from early to late pregnancy.

Conclusions: The results suggest that dietary intervention with probiotics and/or fish oil may have beneficial effect on vaginal microbiota composition, by lowering the abundance of potential pathobionts that have been previously related to adverse pregnancy outcomes such as bacterial vaginosis and preterm birth. However, the vaginal microbial diversity, which has been linked to vaginal dysbiosis, was increased in the fish oil group over the course of pregnancy. Further larger randomized trials are called for to clarify the findings.

Keyword: Vaginal microbiota, Fish oil, Probiotics, Pregnancy, Obesity

PAB(T7-187)

Eggshell membrane-induced keratinocyte differentiation is associated with PKC or/and PI3K-Akt signaling

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Background and objectives: Skin aging is one of the hallmarks of the aging process that causes physiological and morphological changes. We previously indicated that eggshell membrane powder (pESM) suppresses the skin thinning in interleukin-10 knockout mice, and enzymatically digested ESM (eESM) promotes cell differentiation in Neonatal Normal Human Epidermal Keratinocytes (NHEK-Neo) cells. Furthermore, the transcriptome analysis indicated that calcium signaling is upregulated in both experiments. However, it is unclear how ESM regulate calcium signaling. In this study, we focused three signaling pathway (protein kinase C (PKC), phosphatidylinositol-3-protein kinase B (PI3K-Akt), and Notch signal), which are reported to be regulated by extracellular calcium, and performed in vitro experiment.

Methods: NHEK-Neo cells were cultured with KBM™ Gold™ medium with or without 0.5, 1, 2, and 4 mg/ml of eESM. Gene expression was measured by qPCR and protein expression was measured by Western blotting. GF 109203X as PKC inhibitor and LY 294002 as PI3K inhibitor were used to investigate the relationship between above signaling and cell differentiation.

Results: The supplementation of eESM significantly increased expression of *KRT1, KRT10, IVL and KRT13*, which are differentiation markers, and changed cell morphology. And these effects on gene expression was dose-dependent manner. The expression of *HES1* and *ROCK1*, which are downstream of Notch signaling, was not altered by eESM supplementation. In contrast, the expression of genes related to PKC signaling such as IRF6, GRHL3 and OVOL1 were significantly upregulated at a concentration of 4 mg/ml eESM. Western blotting showed that the expression of Akt increased in a dose-dependent manner, and a significant upregulated at a concentration of 4 mg/ml eESM. Furthermore, the addition of GF 109203X and LY 294002 suppressed eESM-induced increase in expression of *KRT1, KRT10* and *IVL.*

Conclusions: This study indicates that eESM promote keratinocyte differentiation possibly via PKC or/and PI3K-Akt signaling pathway. And these findings could contribute to effective utilization of eggshell membrane as, an underutilized resource, especially in skin aging.

Keyword: Eggshell membrane, Keratinocyte differentiation, Skin aging, PKC, PI3K-Akt

Conflict of Interest Disclosure: Y.H. is working as a researcher in ALMADO Inc. in Tokyo. All other authors declare no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-188)
Low methionine highland barley whole grains improve glycemic homeostasis in mice fed a high-fat diet

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Background and objectives: Methionine restriction (MR) can improve blood glucose homeostasis, redox state, alleviate inflammatory response. However, the application of MR theory to real life still needs a lot of research. Research shows that highland barley can improve blood glucose, and it has the lowest methionine content in grains. Its effect on improving blood glucose may be related to its low methionine content. Therefore, this study investigated the effect of low methionine content in highland barley on improving blood glucose.

Methods: C57BL/6J mice were fed a control diet (CON, 0.86% methionine), highland barley high-fat diet (HBHF, 0.17% methionine), or highland barley high-fat with additional methionine diet (HBHFmet, 0.86% methionine) for 25 weeks. Blood glucose, plasma inflammation, lipid, total antioxidant capacity, mRNA related to liver gluconeogenesis, pancreatic function, and skeletal muscle glucose metabolism were mainly measured.

Results: The blood glucose, plasma TG, TC, LDL-C, HDL-C, TNF-α, IL- β, and antioxidant level (T-AOC) of mice fed with HBHF were maintained at normal levels. And mRNA related to liver gluconeogenesis, pancreatic function and skeletal muscle glucose metabolism were also remained at normal levels. However, these beneficial effects were attenuated after supplementation with methionine to normal levels (0.86%). Compared with the CON and HBHF groups, blood glucose, plasma TG, TC, LDL-C, TNF-α and IL-β in HBHFmet group were significantly increased, HDL-C and T-AOC levels were decreased significantly. G6Pase, PEPCK and Foxo1 mRNA were significantly increased in the liver. MafA, PDX and Bcl-2 mRNA were decreased significantly in pancreas, while bax and caspase-3 were increased significantly. The mRNA related to glucose metabolism (Pi3K, Akt, Gsk-3β, IRS-1, GLUT4, PKM, HK2) in skeletal muscle were reduced significantly. These results indicated that the HBHFmet had impaired pancreatic function, increased liver gluconeogenesis and decreased skeletal muscle glucose utilization, resulting in increased blood glucose. After supplementing methionine, the protective effect of low methionine on blood glucose homeostasis in high-fat diet mice was weakened.

Conclusions: Highland barley can keep blood glucose stabilization, partly due to its low methionine content.

Keyword: Methionine restriction, highland barley, blood glucose, high-fat diet

PAB(T7-189)
Sulforaphane promotes Sterol Regulatory Element-binding Proteins (SREBPs) precursor degradation and suppresses the activity of SREBP

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Background and objective: Sterol regulatory element-binding proteins (SREBPs) are transcription factors that regulate various genes involved in cholesterol and fatty acid synthesis. Sulforaphane (SFaN) is an isothiocyanate derived from cruciferous vegetables, such as broccoli, cauliflower, and kale. SFaN reportedly acts through nuclear factor erythroid 2-related factor 2 (Nrf2) transcription factor activation to induce phase II detoxification enzymes, such as NAD(P)H-quinone oxidoreductase 1, glutathione S-transferases, and heme oxygenase.SFaN is also reportedly effective in atherosclerosis, diabetes, and obesity treatment. However, the underlying mechanisms of these SFaN effects are not fully understood.

Methods: Using a luciferase reporter gene assay with the fatty acid synthase (FAS) gene promoter region, we identified SFaN as a natural food component that inhibit SREBP. To investigate the effect of SFaN on SREBP protein and function, we treated human hepatoma Huh-7 cells with 100uM SFaN. Next, we generated SREBP deletion mutants to determine whether SFaN increases ubiquitination of SREBP and to identify the site of ubiquitination.

Results: When Huh-7 cells were treated with SFaN, SFaN reduced SREBP proteins in a time- and concentration-dependent manner by promoting the degradation of the SREBP precursor. This SFaN-mediated SREBP degradation was partly inhibited by MG132, a proteasome inhibitor. Investigations using deletion mutants revealed that the C-terminal region is crucial for the SFaN-mediated SREBP-1a precursor form reduction and ubiquitination. We also found that such SREBP-1 degradation occurs independently of the SREBP cleavage-activating protein (SCAP) and the Keap1-Nrf2 pathway. Several small molecules have been reported to regulate SREBP activity, but the regulatory mechanisms differ among them. At present, it remains unclear what causes this difference. In addition, SFaN administration to obesity model animals shows an anti-obesity effect, with a decrease in serum cholesterol and TG levels. The mechanism by which SFaN exerts these beneficial effects is also still unclear, but the Keap1-Nrf2 pathway is one of the most likely candidates. This study suggests possibilities other than the Keap1-Nrf2 pathway, and further studies are required on these.

Conclusions: This study identifies SFaN as an SREBP inhibitor and provides evidence that SFaN could have major potential as a pharmaceutical preparation against hepatic steatosis and obesity.

Keyword: metabolic syndrome, protein degradation, sterol regulatory element-binding proteins (SREBPs), sulforaphane (SFaN), transcription factor

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-190)
Suppressive effect of UV-irradiated Red perilla on hepatitis induced by carbon tetrachloride in mice

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Background and objectives: Hepatitis has become a global health problem. Carbon tetrachloride (CCl_4) has been widely used to establish hepatic injury in experimental animals. CCl_4 also causes oxidative stress in animals. Red perilla (*Perilla frutescens* [L.] Britton var. *crispa f. purpurea*) displays various biological activities with its bioactive compound. Moreover, ultraviolet (UV) increasing antioxidant activity. However, the protective effect of UV-irradiated red perilla against CCl_4-induced hepatotoxicity has not been clarified. This study investigated the effect of UV-irradiated red perilla on liver injury stimulated by CCl_4 *in vivo*.

Methods: Male 9-week-old ICR mice were randomly divided into four groups. The untreated group (N) and CCl_4-treated model group (C) received 0.5% carboxymethyl cellulose-NA (CMC-Na) without UV-irradiated red perilla by oral gavage once a day for a week. The low-dose (UL) and high-dose (UH) UV-irradiated red perilla groups were administered red perilla extract that has irradiated by UV light at a dose of 25 or 100 mg/kg body weight, respectively, oral gavage once a day for a week. One hour after the last treatment, the C, UL and UH groups were intraperitoneally injected with 10 mL of CCl_4 (0.2% in olive oil) per kg body weight, while the N group received an equivalent volume of olive oil. After 24 h of CCl_4 treatment, all mice were sacrificed under anesthesia. Hepatotoxicity was assessed by measuring serum levels of total bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and Lactose Dehydrogenase (LDH) using standard methods.

Results: High and low dose of UV-irradiated red perilla significantly ameliorated CCl4-induced hepatotoxicity by decreasing the serum level of ALT, AST and LDH.

Conclusions: UV-irradiated red perilla cultivated in a plant factory with artificial light provides hepatoprotection against CC14-induced liver injury in mice. UV-irradiated red perilla would be beneficial in protecting against several diseases related to oxidative stress.

Keyword: Antioxidant, Red perilla, Hepatotoxicity, CCl4, UV-irradiation

PAB(T7-191)
Improvement of storage stability of vegetable oils by using rice bran oil

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Background and objective: Rice bran oil (RBO) is widely used due to its good flavor for cooking and its characteristic antioxidants such as gamma-oryzanols and tocotrienols. To take advantage of these benefits, RBO is sometimes blended to other edible oils. We have shown that addition of RBO to other oils such as rapeseed oil improves the storage stability [1,2], but the detail effect by adding RBO are still not clear. In this study, we investigated the effect and mechanism of blending RBO with linseed oil to improve the storage stability.

Methods and results: Linseed oil mixed with various proportion of RBO were stored at either 60℃, 40℃, or 25℃, then the peroxide value (POV) and aldehydes (propanal and acrolein; major components of unpleasant odor caused by oil deterioration) were measured. The POV and aldehydes were decreased with increasing RBO proportion, especially at 40℃ and 25℃. These values were decreased significantly even with only 10% RBO addition. Furthermore, the linseed oil with 10% RBO addition stored at 40℃ suppressed the carbonyl value and hence maintained the amount of unsaturated fatty acids.

Conclusions: The addition of RBO to linseed oil greatly improved its oxidative stability, especially bellow 40℃. Together with our previous study[1,2], we considered that adding RBO to oil (e.g., linseed oil and rapeseed oil) improves its oxidative stability, probably due to high antioxidant activity of RBO. Many companies have been trying to extend the shelf life of food products and reduce food loss to achieve the Sustainable Development Goals (SDGs). The knowledge from above results will contribute to the achievement of SDGs from the perspective of oils and fats.

Keyword: Rice bran oil, Storage stability, Antioxidant, Aldehyde, Linseed oil

Citation: 1) Koishi, S. *et al.* Antioxidant effect of rice bran oil in long-term storage of edible oils. Presented at the 76th Annual Meeting of Japanese Society of Nutrition and Food Science, subject number 3F-14p, June 12, 2022, Mukogawa women's university. 2) Tsuno, T. *et al.* (2022). Storage stability improver of edible oil and fat at room temperature or less. Japanese patent No. 7029206.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-192)
Identification Of a Cytokine Storm Inhibitor From a Golden Berry Leaf.

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Background: In COVID-19, pneumonia with a strong inflammatory response and inflammatory reactions in blood vessels throughout the body contribute to the severity of the disease. These local and systemic inflammations are thought to be caused by a cytokine storm with overexpression of IL-6, which is believed to be involved in the increase of tissue inflammatory responses mediated by IL-17 and TNFα. Th17 is also known to be involved in various immune diseases. Methods: Solvent extraction was performed from 500 agricultural, forestry, and marine products from the Tohoku region of Japan to construct the food extracted library. Using epithelial fibroblast HeLa cells, we prepared an inflammation model system in which IL-6 overexpression was induced by administration of IL-17 and TNFα, and searched for food-derived components that inhibit IL-6 expression.

Results: 114 polar solvent extracts were selected from the library and screened. As a result, we succeeded in finding 7 anti-inflammatory materials. Among them, the MeOH extract of golden berry (*Physalis peruviana*) leaves had IC_{50} = 4.97 μg/ml. Estimation of anti-inflammatory components by crude fractionation and LC-MS/MS was performed, and a known anti-inflammatory component, 4-beta hydroxywithanolide E (4β-HWE), was identified. 4β-HWE had an IC_{50} = 0.21 µM (0.11 µg/ml). and the content in the extract suggested that it was a major cytokine storm suppressor.

Conclusions: A potent cytokine storm suppressor, 4β-HWE, was identified from a golden berry leaf.

Keyword: Golden berry leaf, Physalis peruviana, 4-beta hydroxywithanolide E, IL-6, cytokine storm

PAB(T7-193)
Functional analysis of LXR during muscle injury and regeneration

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Background and objectives: Skeletal muscle regeneration is an important response to muscle injury and damage which are caused by overload, drugs, and inflammation. It is known that the ability of skeletal muscle regeneration is decreased during aging. Because skeletal muscle mass and strength are important factors to maintain a quality of life, we explored a novel regulator which is activated during muscle injury or regeneration. We found that expression of target genes of LXR, liver X receptor, a nuclear oxysterol receptor, are upregulated during muscle injury. In this study, we analyzed how LXR is activated and how LXR regulates muscle injury.

Methods: Mice were injected with cardiotoxin, a muscle damage inducer. Skeletal muscle was harvested on 3 and 5 days after injection. Mouse muscle cell line C2C12 cells were differentiated using medium containing 2% horse serum. Differentiated C2C12 myotubes were treated with LPS, lipopolysaccharide, mimic muscle damage. Gene expression was analyzed using real-time quantitative PCR. Myotube diameters of C2C12 myotubes were analyzed after immunostaining of myosin heavy chain.

Results: Expression of LXR target genes including ABCA1 were potently upregulated in skeletal muscle injected with cardiotoxin. A mass spectrum analysis revealed that some oxysterols which may activate LXR were significantly increased. LPS-induced inflammation using C2C12 myotubes were used as an *in vitro* model of muscle injury. During inflammation, LXR activation by a synthetic LXR agonist T0901317 increased myotube diameters. LXR increases both phosphorylation of Akt and protein synthesis in C2C12 myotubes.

Conclusions: This study revealed that nuclear oxysterol receptor LXR is activated during muscle regeneration. Increased synthesis of oxysterols may contribute to LXR activation. LXR also increases protein synthesis in C2C12 myotubes. These results suggest a novel regulatory mechanism of muscle injury and regeneration by LXR.

Keyword: skeletal muscle, LXR, oxysterol, muscle injury, muscle regeneration

PAB(T7-194)
Identification of components derived from Pacific krill oil that improve glucose and lipid metabolism

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Background and objectives: Obesity is known to induce insulin resistance through hypertrophy of adipocytes, causing type 2 diabetes. Activation of peroxisome proliferator-activated receptor (PPAR) γ, a ligand-activated transcription factor, is known to induce adipocyte differentiation and improve glucose intolerance. The oil extracted from Pacific krill that inhabits the North Pacific Ocean (Pacific krill oil: PKO) is rich in functional components such as ω3 fatty acids, phospholipids, and astaxanthin. We have previously found that PKO improves glucose and lipid metabolism in mice, which may involve activation of PPARγ. In this study, we attempted to identify the components that activate PPARγ in PKO.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Methods: First, PKO was partitioned with n-hexane and water. Further separation of the components in hexane fraction was performed using high performance liquid chromatography (HPLC). The effect of each fraction obtained by HPLC on PPARγ transcriptional activity was evaluated by luciferase reporter assay using CV-1 cells. The isolated PPARγ activating component was subjected to structural analysis by liquid chromatography-mass spectrometry (LC-MS) and nuclear magnetic resonance (NMR).

Results: The component that activates PPARγ in PKO was contained in the hexane fraction. As a result of repeated fractionation of the hexane fraction by HPLC and luciferase reporter assay, we obtained a fraction containing a single peak and showing PPARγ transcriptional activity. Structural analysis of this fraction by LC-MS and NMR presumed that this component was 11 (Z) -eicosenoic acid.

Conclusions: 11 (Z) -eicosenoic acid was identified as a candidate for PPARγ agonist in PKO. It was suggested that 11 (Z) -eicosenoic acid in PKO may increase small-sized adipocytes through activation of PPARγ and improve glucose and lipid metabolism.

Keyword: pacific krill oil, PPARγ, obesity

Conflict of Interest Disclosure: This study was funded by Koyo Chemical Co., Ltd.
PKO sample was provided by Koyo Chemical Co., Ltd.

Further Collaborators: Non

PAB(T7-195)
Protective effects of D-β-hydroxybutyrate on diabetic nephropathy and myopathy in mice

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Background and objectives: Diabetes mellitus causes not only chronic hyperglycemia, but also some types of complications in kidney, skeletal muscles, and other tissues. Diabetic nephropathy (DN) is a syndrome characterized by inflammation and structural changes with a reduction of glomerular filtration rate in diabetic kidney. Recent studies showed the renal dysfunction is possibly related to impaired energy production such as reduced ATP production in the diabetic kidneys. Ketone bodies have been considered to cause diabetic ketoacidosis, however, recent paper showed that SGLT2 inhibition protects from DN by endogenous ketone body synthesis. In this study, we investigated the protective effect of dietary ketone body D-β-hydroxybutyrate (DBHB) on diabetic nephropathy in a streptozotocin (STZ)-induced diabetic mouse model and further tested the protective effect of DBHB on diabetic myopathy.

Methods: C57BL/6J mice were injected intraperitoneally with 125mg/kg STZ for two consecutive days, and three days after the STZ administration, these mice were divided into two groups, the diabetic group (DM) maintained in 0.9% NaCl water and DBHB group (KB) maintained in a DBHB water with an equal Na amount. DBHB was provided from Osaka Gas (OKETOA D-BHB). Kidney and skeletal muscle were isolated and subjected to RNA and histological analyses.

Results: DBHB supplementation showed less kidney mass. mRNA analyses showed that the expression levels of inflammation- and fibrosis-related genes are down-regulated in the kidney of KB group and that energy metabolism- and muscle atrophy-related genes in the skeletal muscle were significantly improved in KB group, even though there was no difference in blood glucose level between two groups.

Conclusions: This study suggests that DBHB supplementation can improve diabetic nephropathy. We will further test the protective effect of DBHB on diabetic myopathy and show a possibility that dietary DBHB protects from diabetic complications.

Keyword: D-β-hydroxybutyrate, Ketone Body, Diabetic Nephropathy, Diabetic Myopathy, STZ

PAB(T7-196)
Auraptene, a citrus polyphenol attenuates an aortic aneurysm formation through the suppressing osteoclastogenesis in the artery in Ca-PO_4-induced mouse model.

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Background and objectives: The mortality rate of aortic aneurysm is severely high not only in the West but in Asia including Japan. Generally, a typical therapy for this disorder is a surgical approach, and the effective medicine hasn't still been existed. Recently, we found that osteoclasts expressed in lesions of the patients with aortic aneurysm and anti-osteoporosis drug bisphosphonate could suppress aneurysm formation. However, bisphosphonate frequently has side effects like a BRONJ, bisphosphonate-related osteonecrosis of the jaw and gastroenteropathy. Thus, other internal medical way is still required. No report has been discussed about the effect of a food factor which ameliorates osteoporosis, on aneurysm formation. Here, we unveiled the preventing function of auraptene, a citrus polyphenol to aneurysm formation via anti-osteoclastogenic property.

Methods: Mouse macrophage RAW264.7 cells were used for investigating the effect of auraptene on osteoclastogenesis. For the osteoclast differentiation analysis, 7,000 cells were plated at each well into 96-well plate and stimulated with 100 ng/ml recombinant human sRANKL with or without 20 mM auraptene. Five days after stimulation, osteoclasts were detected by tartrate-resistant acid phosphatase (TRAP) staining. Western blot analysis evaluated expression of a secretary matrix metalloprotease (MMP)-9, which is a well-known contributor for aneurysm formation. Auraptene (40 mg/kg/day) were orally

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

injected twice a day into 7 weeks-old ddY male mice from 1 day before Ca-PO_4 surgery as an experimental aneurysm model. At 7 days after surgery, the mice were dissected, and maximum diameters of the arterial lesion was measured. Obtained arterial samples were frozen-sectioned and analyzed by using TRAP staining, and von Kossa staining to detect an ectopic calcification. Because the calcification of blood vessel is a trigger to accelerate osteoclastogenesis in artery.

Results: Auraptene inhibited osteoclast differentiation of RAW264.7 cells through, followed by decreasing MMP-9 secretion. *In vivo* analysis showed auraptene reduced expansion of arterial diameter but had no effect on vascular calcification by inducing Ca-PO_4 surgery.

Conclusion: Auraptene attenuated Ca-PO_4 induced aneurysm through suppression of osteoclastogenesis in artery, suggesting that this citrus polyphenol counted on as a therapeutic supplement for aortic aneurysm.

Keyword: Food factor, Auraptene, Aneurysm, Osteoclast

PAB(T7-197)
Vitamin A-responsive LGR6 promotes myoblast differentiation

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Background and objectives: Skeletal muscles are formed through a complex process that involves differentiation. Therefore, it is important to understand the process of myoblast differentiation in maintaining and enhancing the skeletal muscle health. The active form of vitamin A, all-trans retinoic acid (ATRA), promotes myoblast differentiation via retinoic acid receptors (RAR) that function as transcription factors. However, limited information is available on the target genes of RARs that regulate myoblast differentiation. We previously demonstrated that the expression of leucine-rich repeat-containing G protein coupled receptor 6 (LGR6) is upregulated in response to ATRA in skeletal muscle cells[1]. The purpose of this study was to obtain information on the expression mechanism of LGR6 expression by ATRA and the role of LGR6 in myoblast differentiation involved in skeletal muscle formation.

Methods: Murine C2C12 myoblasts were induced to differentiate into myotubes in the presence or absence of ATRA. The effect of RAR agonists on Lgr6 mRNA expression was assessed. Furthermore, C2C12 myoblasts were transfected with Lgr6 siRNA and induced to differentiate.

Results: In the presence of ATRA, *Lgr6* mRNA expression was transiently increased by 3 h after myoblast differentiation and then decreased to its basal levels by 12 h after induction of differentiation. The RAR-specific pan-antagonist AGN193109 completely inhibited the ATRA-induced increase in *Lgr6* mRNA expression. The RARα agonist AM580 and RARγ agonist BM961 increased *Lgr6* mRNA expression. The *Lgr6* mRNA expression during differentiation transiently increased earlier than the mRNA expression of myogenin (*Myog*; a myogenic transcription factor), myomaker (*Mymk*), and myomerger (*Mymx*; factors that promote myoblast fusion). Furthermore, *Lgr6* knockdown decreased the differentiation and fusion indices, and reduced the *Myog, Mymk,* and *Mymx* mRNA expression. Furthermore, exogenous LGR6 overexpression increased the *Myog, Mymk*, and *Mymx* mRNA expression 3 h after inducing differentiation.

Conclusions: The present study suggests that ATRA up-regulates Lgr6 mRNA expression via RARα and RARγ and indicates that LGR6 is transiently required to promote the early stage of myoblast differentiation.

Keyword: skeletal muscle, vitamin A, LGR6, myoblast differentiation, murine C2C12 myoblast

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PAB(T7-198)
Extracts from *Chlorella vulgaris* induce rapid proliferation of muscle cells in serum-free condition

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Background and objectives: World population will grow from 7.2 billion today to 9.6 billion in 2050 along with a strong demand for meat in 2050 projected to grow by 73 and 58 percent, respectively (FAO, 2011). To overcome the shortage of meat and milk production, artificially cultured meat has created quite a stir. However culturing mammalian cells require large volume of expensive culture media (Dulbecco`s modified Eagle`s medium) and serum (Fetal bovine serum) to sustain in-vitro cell culture. For now, almost 50 L of media is required to produce 1 kg of cultured meat and the expense ranges from 3000-4000. Hence, coming up with an alternative source of serum supplement is necessary to reduce the cost of cell culture. This research aims at establishing an alternative mammalian cell culture medium that is cheap and eco-friendly. Micro-algae have an immense application in the pharmaceutical and nutraceutical industries, biodiesel and wastewater management system. It is a fundamental part of food consumption as well. Hence, we aim at extracting growth factors and functional metabolites from micro-algae and apply on mammalian myoblast cell culture to enhance the proliferation rate.

Methods: We found extracts obtained from *Chlorella vulgaris* through ultrasonication method has a potential to influence myoblast cell proliferation. In order to investigate further, the extract was purified and the compounds soluble in water (CW) was collected by utilizing our new separation method.

Results: We found some astounding results. Compounds soluble in water (CW) has a capability to proliferate mammalian cells, C2C12 cells, without fetal bovine serum (FBS). These

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

mammalian cells showed high proliferation rate, comparable to the cell proliferation using DMEM supplemented with FBS. Currently, we are identifying the components present in CW as well its effect on signal transduction process on myoblast cells.

Conclusion: Hence, with further research and optimization of CW components we will introduce CW as an eco-friendly, cheaper alternative growth promoting supplement to the scientific community. It will not only boost the cultured meat industry but will also have a huge impact on various fields of biosciences like regenerative medicine, gene/cell therapies, production of biopharmaceutical and antibody therapeutics.

Keyword: Mammalian cell proliferation, Chlorella vulgaris, Serum-free culture, Ultra-sonication

PAB(T7-199)
Sargassum macrocarpum exhibits anti-IgE-mediated allergic activity by suppressing IgE secretion by U266 cells and inhibiting degranulation of RBL-2H3 cells.

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Background and objectives: The number of people suffering from allergic diseases is increasing, especially in developed countries. Therefore, anti-allergic ingredients in natural product have been attracting attention. While the brown algae *Sargassum macrocarpum* has low food value and is currently considered an underutilized resource, it is abundant in available resources because it forms large colonies. Few studies have examined the anti-allergic activity and exact mechanism of action of *Sargassum macrocarpum*. Seaweed are widely known to have a variety of pharmacological ingredients. Therefore, the present study investigates the anti-allergic effect of an ethanol extract from *Sargassum macrocarpum* (SME).

Methods: SME was obtained by ethanol extraction of dried *Sargassum macrocarpum* collected in Tsukumo Bay. Further, SME was fractionated and purified to isolate the compound. The cells were pre-treated with various samples for 24h. We evaluated IgE secretion and IgE gene expression in U266 cells. For *in vitro* model of IgE-mediated mast cell degranulation, DNP-IgE-sensitized RBL-2H3 cells challenged with DNP-HSA. The β-hexosaminidase release rate of RBL-2H3 cells was measured.

Results: SME reduced IgE secretion from U266 cells in a dose-dependent manner. At 1.25 μg/mL, IgE secretion was suppressed by about 80%. On the other hand, no significant decrease in IgE gene expression was confirmed by the addition of SME. Furthermore, SME suppressed the release of β-hexosaminidase in DNP-IgE-sensitized RBL-2H3 cells. We identified anti-allergic candidate substances in SME.

Conclusions: It was suggested that SME inhibited the secretion of IgE produced in plasma cells to the extracellular space. In addition, SME inhibited the release of inflammatory mediators by suppressing the degranulation of mast cells. These results in this study suggests that SME has an anti-IgE-mediated allergic effect.

Keyword: Anti-allergic, Immunoglobulin E, degranulation, Sargassum macrocarpum

PAB(T7-200)
Improvement of lipid metabolism by piceid, a glycoside of resveratrol

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Background and objectives: Resveratrol, a phytoalexin and antioxidative polyphenol found in red wine and various plants, is associated with a reduced risk of cardiovascular diseases. We reported that resveratrol activates nuclear receptor PPARα, β/δ and γ, which are considered molecular targets against lifestyle-related diseases by regulating lipid and carbohydrate metabolism, in cell-based reporter assay and the intake of resveratrol improves lipid metabolism in mice through PPARα-dependent mechanism. Based on these dates, we have been working on PPARs as potential molecular targets of resveratrol. On the other hand, piceid, a glycoside of resveratrol, is also found in red wine and various plants and may exert various physiological effects as well as resveratrol. In this study, we examined improvement of lipid metabolism by piceid and involvement of PPARα.

Methods: Male wild type (C57BL/6J) and PPARα-knockout mice (7 to 9-week-old) were fed the normal diet (AIN93-G) or the same diet supplemented with 0.4% piceid. After 8 weeks of feeding, blood sample and tissues were harvested for each analysis. Moreover, we also tested anti-atherosclerosis by administering piceid with a normal diet to male apolipoprotein E knockout mice (8 to 10-week-old). After 12 weeks, aorta was collected and stained with oil red O for pathologic analysis.

Results: Eight-week intake of piceid with a normal diet was decreased plasma triglyceride levels in the wild-type but not in PPARα-knockout mice. Hepatic expression of lipid metabolism-related genes such carnitine palmitoyltransferase 1, cyp4a14, acyl CoA oxidase and fatty acid binding protein 1 was upregulated in PPARα-dependent or -independent manner. Moreover, we also found the increase of plasma HDL-cholesterol, the decreases of plasma total and non-HDL cholesterol, and the suppression of lipid accumulation in aorta by feeding piceid in apolipoprotein E knockout mice. These effects were not found in apolipoprotein E/PPARα double knockout mice.

Conclusions: The intake of piceid improved lipid metabolism partially via PPARα. The effects of piceid were similar to resveratrol. These findings indicate that piceid will afford beneficial effects of preventing lifestyle-related diseases.

Keyword: Piceid , Resveratrol, Lipid metabolism, PPAR

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-201)
Effects of sugar cane juice non-sucrose fraction on starch induced hyperglycemia on mice

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Background and objects: The sugar cane juice non-sucrose fraction is commonly referred to as molasses and is produced as a byproduct of sugar extraction from sugar-making raw materials made by concentrating sugar cane juice. It is attracting attention as a new functional food material because of its rich mineral and polyphenol content and bio-regulatory functions such as antioxidant and anti-inflammatory activities. In this study, we investigated that the effects of sugar cane juice non-sucrose fraction (SJNoS) (81.9% solids, 40.4% total sugar) on starch induced hyperglycemia using oral starch tolerance test (OSTT), and further speculated their active ingredients and mechanisms.

Methods: Male ICR mice under overnight fasting were orally administrated 20% water soluble starch with or without SJNoS, and then their blood glucose levels were analyzed at individual time points (0, 30, 60, 120, 180 min) using glucose meter. SJNoS was fractionated into water soluble fraction (W-Fr), ethanol insoluble fraction (Et-Fr), ethyl acetate soluble fraction (EAc-Fr), and hexane soluble fraction (Hx-Fr) by two-phase distribution. The effects of individual fraction on starch induced hyperglycemia using same model described above. In addition, the inhibitory effects of SJNoS and individual fraction on α-amylase and α-glucosidase activities were measured using *in vitro* methods.

Results: Starch administration increased blood glucose levels, reaching a peak at 60 minutes after administration. On the other hand, simultaneous administration of SJNoS markedly suppressed this increase, and the area under the curve at 240 minutes after administration was significantly suppressed. Simultaneous administration of each fraction and starch showed an inhibitory effect in both W-Fr and Et-Fr groups. SJNoS significantly inhibited the α-glucosidase activity, but not α-amylase. Similar results were observed in both W-Fr and Et-Fr.

Conclusions: These results suggest that SJNoS has the potential to suppress postprandial hyperglycemia via α-glucosidase inhibition.

Keyword: Sugar cane juice non-sucrose fraction, Hyperglycemia, Starch, α-glucosidase, Mice

PAB(T7-202)
Impact of short-term isolation stress on urinary stress hormone excretion

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Background and objectives: Exposing stressors on mammals, stress hormones are secreted from adrenal glands to blood, consequently excreted into urine. Catecholamines or cortisol (corticosterone in rodents) are produced by the activation of sympathetic adrenomedullary axis (SAM axis) or hypothalamic-pituitary-adrenal axis (HPA axis). By the determination of urinary stress hormone levels, it can estimate the state of stress in the animals. In the previous studies, urine collection from the rodents for measuring stress hormone levels was carried out by a single housing mouse. On the other hand, mouse in single-housing exposes potent social isolation stress, consequently showing depression and anxiety-like behavior. In this study, we compared the levels of urinary stress hormone between mice in single- or pair-housing to verify the validity of the conventional evaluation methods.

Methods: A mouse (single-housing group) or two mice (pair-housing group) was housed in metabolic cages for 4 days. Each day during that period, they were weighed, and collected their daily urine into a tube filled with 6N hydrochloric acid. Urinary noradrenaline and adrenaline were determined by HPLC equipped with an electrochemical detector, and their final metabolites, vanillylmandelic acid (VMA) were determined by UPLC-MS/MS. Urinary corticosterone levels were measured using ELISA kit. The level of stress hormone excretion was corrected by urinary creatinine levels.

Results: Compared with the pair-housing group, the bodyweight of the single-housing group significantly decreased from day 1, and this change was not recovered during the experimental period. The total amount of catecholamines and corticosterone excreted into urine for 4-days was markedly increased in the single-housing group compared to the pair-housing group.

Conclusions: Significantly decreasing body weight and increasing urinary catecholamine and corticosterone in the single-housing group compared with the pair-housing group. It was found that short-term social isolation stress activated the HPA and SAM axis and increased the excretion of stress hormones. Therefore, when verifying the effects of the bioactive compounds on sympathetic nerve activity (e.g. capsaicin), using the urine collected by pair-housing is more appropriate than single-housing.

Keyword: Social isolation, Stress, Urine, Catecholamine

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-203)
Anti-proliferative effect of germinated djulis (*Chenopodium formosanum*) in human colorectal cancer cells

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Background and objectives: Colorectal cancer (CRC) is one of the most common cancers in the world. Djulis (*Chenopodium formosanum*) is a plant native to Taiwan, which contains more dietary fiber, phytochemicals and minerals than commonly consumed cereals. Djulis has been shown to prevent pre-cancerous colorectal lesions. Germination is an extensive way to increase the nutritional value of seeds because it produces physiologically active components and increases bioavailability of nutrients. This study was conducted to investigate the effect of germinated djulis (GD) and ungerminated whole djulis (WD) on CRC and to elucidate its possible mechanisms.

Methods: WD was soaked in warm water at 40°C for two hours, germinated at 25°C for 72 hours, and then collected as GD. Both WD and GD were ground into powder, extracted with water at 25°C, dried and analyzed for γ-aminobutyric acid (GABA), total phenolic content (TPC) and total flavonoid content (TFC). The extracts were intervened in HT-29 human CRC cells to investigate their anti-cancer activity.

Results: GD had significantly higher extraction rate and GABA content than did WD. In contrast, TPC and TFC were significantly higher in WD compared with GD. GD showed a stronger inhibitory activity on HT-29 cells than did WD. WD significantly increased the expression of pro-apoptotic Bcl-2-associated X (BAX) in HT-29 cells, while the expression of anti-apoptotic B-cell lymphoma family 2 (Bcl-2) did not differ between WD and GD groups.

Conclusions: Germination may increase the extraction rate, GABA content and anti-CRC effect of djulis. However, apoptosis is not the major mechanism of germinated djulis for inhibiting the growth of CRC cells.

Keyword: Djulis, Germination, Water extract, Colorectal cancer cells, Apoptosis

PAB(T7-204)
Analysis of immunomodulatory and anti-allergic functions of *Cyclopia* extracts

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Background and objectives: The number of patients suffering from immune disorders such as allergies, ulcerative colitis, cancer, and infectious diseases is increasing. Although drugs have been developed to alleviate symptoms, fundamental cure has not been established. On the other hand, food factors with immunomodulatory activity show promise in preventing and treating such diseases. While immunomodulatory foods are attracting attention in this way, we are focusing on *Cyclopia species* indigenous to South Africa that have been used as an herbal tea, honeybush tea, for many years. Honeybush tea has been reported to have beneficial health effects such as antioxidant, anticancer, and antimutagenic properties. Therefore, in this study, we aimed to analyze the immunomodulatory and antiallergic effects of *Cyclopia* extracts.

Methods: *Cyclopia* extracts were dissolved in drinking water and given to ovalbumin (OVA)-specific T cell receptor transgenic mice (DO11.10). The mice were then fed a diet containing OVA, and blood was collected to prepare serum. The serum was used for antibody production assays. The splenocytes of the mice were prepared and subjected to flow cytometry to analyze the induction of Treg cells. DO11.10 mice were also administered OVA by inhalation to make an allergy model and the effect of *Cyclopia* extracts on allergic symptom was evaluated.

Results: Aqueous and 40% EtOH-water extracts of *Cyclopia genistoides, Cyclopia subternata*, and *Cyclopia maculate* were tested and the 40% EtOH-water extracts of *C. genistoides* and *C. subternata* showed to have the most promising immunomodulatory functions in the *in vitro* screening assay. The *in vivo* study clearly showed that oral administration of the two extracts to DO11.10 mice significantly enhanced antibody production and induction of regulatory T cells simultaneously, consistent with the results of *in vitro* studies. Furthermore, the *Cyclopia* extracts suppressed systemic anaphylactic symptoms in the OVA-inhalation murine model of allergy.

Conclusions: *Cyclopia* extract is expected to be a promising ingredient with immunomodulating and anti-allergic functions.

Keyword: Honeybush, Immune-regulation, Allergy, IgE, anaphylaxis

PAB(T7-205)
Effects of dietary β-conglycinin on energy expenditure and lipid metabolism in Otsuka Long-Evans Tokushima Fatty (OLETF) rats

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Background and objectives: Beta-conglycinin (β-CON), one of the major components of soy protein (SOY), has been shown to lower body fat mass and lipid levels. The effects could be partly associated with an increase of serum adiponectin concentration. Since adiponectin was demonstrated to control energy metabolism, the feeding of β-CON could also modulate energy consumption. In the present study, therefore, we examined how β-CON affected energy expenditure and lipid metabolism in obese Otsuka Long-Evans Tokushima Fatty (OLETF) rats.

Methods: The 14% high-fat diets were prepared according to the AIN-93G formula, containing either 20% casein (CAS), or the CAS replaced with SOY or β-CON at the proportion of 50%. The animals (5 week-old) were fed with the diets for 6 weeks. On day 35, the respiratory quotient was measured to calculate energy expenditure. After the feeding period, blood was collected from the abdominal vena cava and serum was prepared. The liver, white and brown adipose tissues and soleus muscle were excised.

Results: Total energy consumption in the β-CON group was significantly higher than that in the CAS and SOY groups, concomitant with an increase of serum adiponectin level. Final body weight in the β-CON group was significantly lower than that in the CAS and SOY groups, while food consumption was comparable among the groups. The expression of genes related to energy metabolism (i.e. peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1α) and carnitine palmitoyltransferase 1b (CPT1b) in the soleus muscle and uncoupling protein 1 (UCP1) in the brown adipose tissue) was higher in the β-CON group than in the CAS and SOY groups. The mesenteric adipose tissue weight was also significantly lower in the former than in the latter. Dietary β-CON compared with CAS decreased triglyceride concentration in the liver, being associated with a decrease of fatty acid synthesis and an increase of fatty acid β-oxidation in the liver.

Conclusions: The results suggested that dietary β-CON was involved in energy expenditure to improve lipid metabolism through an increase of serum adiponectin concentration in OLETF rats.

Keyword: β-conglycinin, energy expenditure, adiponectin

PAB(T7-206)
Verification of the anti-obesity effect of mixed probiotic (*Bifidobacterium animalis ssp. lactis* and *Lactobacillus rhamnosus*) in high-fat diet-induced obese mice

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Background and objectives: Obesity has become a worldwide health problem with severe complications such as type 2 diabetes and cardiovascular diseases. *Bifidobacterium animalis* ssp. *lactis* (Bf141) and *Lactobacillus rhamnosus* (Lb102) have been proven to prevent metabolic diseases. This study aimed to screen the anti-obesity effect of mixtures of *Bifidobacterium animalis ssp. Lactis* (Bf141) and *Lactobacillus rhamnosus* (Lb102).

Methods: Four-week-old C57BL/6N mice were administered the mixture of Bf141 and Lb102 (50% Bf141, 30% Lb102, and 15% maltodextrin) with a high-fat diet (60% kcal from fat) for eight weeks. Mice were randomly assigned into three groups; 1) the control group (only distilled water), 2) the low group (2.5×10^9 CFU), and 3) the high group (10×10^9 CFU). Water and diet were fed *ad libitum.*

Results: The mixed probiotic did not alter the adiposity, including body weight and fat in tissue. Liver weight was not changed, which is the center of lipid synthesis. Furthermore, the lipid content in feces, an indicator of lipid digestion and absorption, is not modified. Serum triglycerides and total cholesterol levels are also not significantly different.

Conclusions: These findings imply that the mixed probiotic (Bf141 and Lb102) does not have an anti-obesity effect in high-fat diet-induced obese mice. In a future study, it is necessary to design various mixing conditions and concentrations to demonstrate the effect of mixed probiotics on obesity.

Keyword: Bifidobacterium animalis ssp. lactis Bf141, Lactobacillus rhamnosus Lb102, anti-obesity, probiotic

PAB(T7-207)
Identification of a food-derived molecule which induces the anti-obese hormone FGF21

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Background and objectives: Fibroblast growth factor 21 (FGF21) is a hepatokine which regulates energy metabolism. FGF21 has several beneficial effects including an increase of energy expenditure and weight loss, indicating that FGF21 acts as an anti-obese hormone. In the liver, expression of FGF21 is

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

induced by a variety of nutritional and stress signaling. We previously reported that endoplasmic reticulum stress potently induces FGF21 expression through an activation of transcription factor ATF4. A multiple ATF4-binding sites are present in the promoter region of FGF21 gene, suggesting that FGF21 is a highly sensitive target of ATF4. In this study, we explore food-derived molecules which activate ATF4-FGF21 pathway to identify anti-obese food ingredients.

Methods: A luciferase reporter assay of ATF4 using HEK293 cells was performed for a screening of food derived molecules (>300). An analysis of endogenous expression was investigated using real-time quantitative PCR or western blotting. Knockdown experiments were performed by siRNA transfection using human hepatoma cell line HepG2.

Results: Using the ATF4-driven reporter assay for screening a food derived molecule, we identified bergamottin, a furanocoumarin present in grapefruits, as an ATF4 activator. Bergamottin increases endogenous expression of both ATF4 and FGF21 in HepG2 cells. ATF4 is known to be activated by translation upon stress signaling through four eIF2α kinases (PERK, GCNS, HRI, and PKR). Experiment using siRNA or inhibitors showed that bergamottin activates ATF4 through PERK. Bergamottin does not induce endoplasmic reticulum stress which is upstream signal of PERK, suggesting an existence of another mediators. From series of experiments, we identified that Rheb, an interacting protein of PERK, is an important mediator of bergamottin signaling. In addition to bergamottin, we found some other furanocoumarins including dihydroxybergamottin activate ATF4-FGF21 pathway.

Conclusions: This study revealed a natural inducer of the anti-obese hormone FGF21. Because FGF21 has several beneficial effects on energy metabolism, bergamottin may be a candidate of a functional food ingredients to inhibit metabolic syndromes.

PAB(T7-208)
Cyanidin Inhibits Adipogenesis in 3T3-L1 Preadipocytes via the PLC-IP_3 Pathway and Intracellular Ca^{2+} Signaling

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Background and objectives: Cyanidin is the most abundant anthocyanidin found in red-purple fruits and has antioxidant, antidiabetic, and anti-obesity properties. However, the mechanisms that cause the anti-adipogenic impact have not been fully identified. The aim of this study was to elucidate the anti-adipogenic mechanism of cyanidin through the inhibition of adipogenesis in preadipocytes.

Methods: Mouse 3T3-L1 preadipocytes were cultured in an adipogenic medium supplemented with cyanidin. Adipogenesis, cell viability, and adipogenic gene expression were evaluated using Oil Red O staining, MTT assay, and RT-qPCR, respectively. Cyanidin's mechanism of action was studied via intracellular Ca^{2+} signaling using real-time Ca^{2+} imaging analysis.

Results: The results showed that the addition of cyanidin (1-50 μM) to the adipogenic medium inhibited adipogenesis and downregulated the expression of adipogenic marker genes (PPARγ, C/EBPα, adiponectin, and aP2), with no effect on cell viability after 4 days of treatment. Furthermore, exposure to cyanidin concentrations up to 100 μM for 1 hour did not affect cell viability. The results of real-time Ca^{2+} imaging analysis indicated that cyanidin (30-100 μM) increased intracellular Ca^{2+} signals. Pretreatment of cells with U73122 (a PLC inhibitor) and 2-APB (an IP_3 receptor blocker) inhibited the intracellular Ca^{2+} signals by cyanidin. In addition, the depletion of endoplasmic reticulum Ca^{2+} stores by thapsigargin (TG) also abolished the cyanidin-stimulated Ca^{2+} signals.

Conclusions: Our findings demonstrate that cyanidin activates the PLC-IP_3 signaling pathway to stimulate intracellular calcium signals, which inhibits adipogenesis and the expression of adipogenic genes. This study has revealed for the first time the underlying mechanism of the anti-adipogenic effect of cyanidin through activated intracellular Ca^{2+} signaling.

Keyword: Cyanidin, Adipogenesis, Gene expression, PLC-IP3 pathway, Ca2+ signaling

Conflict of Interest Disclosure: The authors declare no conflict of interest.

PAB(T7-209)
Non-destructive analysis of lignan in sesame oil

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Background and objective; Lignan is one of the most important functional component in the sesame oil with strong antioxidant activity, so understanding its content is a key to maintain its quality. Although HPLC, general method to determine lignan concentration, is selective and sensitive, it is time-consuming and somewhat cumbersome. On the other hand, as a simple and rapid non-destructive analysis of foods and agricultural products, Fourier transform near-infrared spectroscopy (FT-NIR) has been attracting attention and widely used due to its high transmittance. In sesame oil, NIR analysis of major component such as fatty acid composition has been reported so far, but analysis of trace functional components such as lignan has been rarely performed. Therefore, in this study, we aimed to develop a non-destructive quantitative analysis method for lignans contained in sesame oil using FT-NIR.

Methods; 150 of sesame oils with different lignan concentrations were used. Lignans (sesaminol, diasesamine, sesamin, episesamin and sesamolin) were measured by HPLC. Sesame oil was placed in an 8 mm vial (6.6 mm i.d. vial) and its

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

NIR absorption spectra (12500 cm^{-1} - 4000 cm^{-1}) was obtained by FT-NIR spectrometer (MPA, Bruker Optic). Both spectra of background and sample were integrated with 128 scans with 8 cm^{-1} resolution. Based on the obtained spectral data and the quantitative values obtained by HPLC, a calibration model was created by the partial least square (PLS) regression. The prediction model was verified by cross-validation method and the accuracy of the model was confirmed by the determination coefficient (R^2), residual predictive deviation (RPD), and root mean square error (RMSE), respectively.

Result and Conclusions; Each PLS prediction model to determine sesaminol, diasesamin, sesamin, episesamin and sesamolin by FT-NIR was successfully developed. In developed PLS model, the R^2 and RMSE were 0.91-0.99 and 0.016-0.041, respectively. The accuracy of the calibration model was confirmed by enough RPD (3.3-11.1). Therefore, the simple and rapid non-destructive analysis of each characteristic lignan in sesame oil was achieved by FT-NIR even its component is a trace amount and chemical structure is similar. This method will be contribute to keep the sesame oil quality in the industrial process.

Keyword: Sesame oil, lignan, FT-NIR, non-destructive analysis

PAB(T7-210)
Effect of mung bean peptides on maintenance of muscle mass

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Background and objectives: Musculoskeletal disorders have become a big problem in the super-aging society in Japan. The maintenance of muscle mass is one of the preventive measures for extension of healthy life expectancy. The functional evaluation of the peptide of mung bean is not sufficient on the maintenance of skeletal muscle mass. Therefore, in this study, we searched for mung bean peptides that contribute to the maintenance of skeletal muscle mass and elucidated their mechanism.

Methods: The mung bean peptide was digested with pepsin, trypsin and chymotrypsin from its protein powder and subjected to gel-filtration column chromatography, weak anion exchange column chromatography, high-performance liquid column chromatography and mass spectrometry to purify and identify the peptides. To examine the effect on skeletal muscle mass, mouse fibroblasts C2C12 differentiated into myotubes were used. The myotubes were treated with several concentration of mung bean peptides and subjected to SUnSET method and western blotting for protein synthesis. To evaluate preventive effect of the mung bean peptides against muscle atrophy, the myotubes were treated with the mung bean peptides and stimulated with 1 μM dexamethasone for 24 h and then subjected to western blotting. Competitive assay with molecular probes of the peptides was performed to assess the mung bean peptides competition for dexamethasone-glucocorticoid receptor binding.

Results: Treatment of mung bean peptides increased protein synthesis in C2C12 myotubes. The peptides induced the phosphorylation of mTOR and p70S6K. Furthermore, the peptides inhibited dexamethasone-induced the expression of ubiquitin ligases, MuRF1 and Cbl-b via suppression of glucocorticoid receptor translocation. Its mechanism is competitive inhibition against dexamethasone by directly bind to the glucocorticoid receptor.

Conclusions: It was revealed that mung bean peptide contributes to the maintenance of skeletal muscle mass by promoting protein synthesis and suppressing proteolysis.

Keyword: mung bean peptide, muscle mass

PAB(T7-211)
Determination of the bioaccessibility of compounds with antioxidant activity from orange juice subjected to an *in vitro* digestion system

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Background and objectives: Citrus fruits, among which the orange (*Citrus sinensis)* stands out, have a high commercial value both fresh and in the food industry. Vitamin C is their most recognized nutrient, but they also provide phenolic compounds of vital importance to improve human health due to their antioxidant properties. However, during the digestion process, food components are constantly exposed to different physicochemical and biochemical conditions and, consequently, the bioavailability and bioactivity can be affected. The objective of the study was to determine the bioaccessibility of the phenolic profile and vitamin C in orange juice subjected to an *in vitro* digestion system.

Methods: *In vitro* digestion of orange juice was performed. Porcine pepsin was used in gastric phase (pH=2 with HCl). For intestinal phase, porcine bile and pancreatin were used (pH=5.3 with NaOH). For bioaccessible phase, the membranes were filled with NaHCO (pH=7 with NaOH). The determination of total polyphenols in samples was carried out following the Folin-Ciocalteu method and the antioxidant activity, by the DPPH and FRAP methods. The profile of phenolic compounds and the content of vitamin C was determined by high performance liquid chromatography (HPLC).

Results: The content of vitamin C, after *in vitro* digestion, decreased by 84% (only 16% of the total quantified in the juice was preserved). Of the total polyphenol content, 37% was preserved and, regarding antioxidant activity, 14 and 12% bioaccessibility was observed for DPPH and FRAP, respectively. The highest concentration of phenolic compounds was narirutin,

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DOI: 10.1159/000530786

followed by hesperidin, kaempferol, hesperitin, naringenin and quercetin. On the other hand, the highest bioaccessibility was found in hesperitin and the lowest in hesperidin (93 and 3%, respectively).

Conclusions: Although the hesperidin content is high, its percentage of bioaccessibility was the lowest compared to the other phenolic compounds analyzed. The bioaccessible portion of vitamin C and the total antioxidant activity of orange juice is less than 20% of the content in the food. Therefore, it is necessary to perform *in vivo* experiments to provide relevant information on the real experience of the consumption of citrus beverages.

Keyword: Orange juice, Bioaccessibility, Antioxidants

PAB(T7-212)
Evaluation of the antihypertensive activity of chia seed extracts (*Salvia hispanica*)

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Background and objectives: Hypertension is a chronic disease and a major public health problem that represents third of adult population worldwide and it is considered a major risk factor for cardiovascular disease. In this context, there is a growing interest in finding alternatives that improve its prevention and treatment. The aim of this study was to evaluate the in vitro angiotensin-converting enzyme (ACE) inhibitory activity of phenolic compounds present in ethanolic and methanolic *Salvia hispanica L*. (chia) seed extracts.

Methods: Chia seeds used in this project were cultivated in Mexico. Extracts were made with 50 g of chia in 250 mL of methanol or ethanol and were macerated during 48 h and were concentrated by rotary evaporation. Chia seed extracts were subjected to acid hydrolysis process to break the glycosidic bond between the aglycone (compound in free form) and its sugar to be quantified in both forms. The major phenolic compounds were quantified by high performance liquid chromatography (HPLC). ACE inhibitory activity was determined by *in vitro* enzyme assay using the hypuryl-L-histidyl-L-leucine (HHL) reagent as substrate.

Results: Myricetin was the main phenolic compound found in both extracts, followed by chlorogenic and caffeic acid, myricetin, quercetin and kaempferol. Most of them were found in conjugated form (50 and 73 % for ethanolic and methanolic extract, respectively). Extracts exhibited inhibitory ACE activity, IC_{50} values of extracts were 7.1 and 2.1 mg/mL for ethanolic and methanolic extract, respectively.

Conclusions: Methanolic extract presented the highest concentration of phenolic compounds and an *in vitro* inhibitory ACE activity three times superior compared to ethanolic extract. These results may suggest that the phenolic compounds contained in chia seed extracts have the potential to be used in the development of adjuvant agents in the treatment of hypertension, presenting the advantage of being derived from a food matrix.

Keyword: Chia Seed, Inhibitory ACE , Hypertension, Phenolic Compounds

PAB(T7-213)
Comprehensive proteome analyses revealed the signal transduction of skeletal muscle hypertrophy

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Background and objectives: Skeletal muscle comprise approximately 40% of the total body weight, and play fundamental roles in energy metabolism. They can adapt intramuscular metabolism to suit various environmental conditions for maintaining homeostasis. We set two different experimental models, fish protein feeding model and treadmill training model, to investigate the mechanism relying on muscle hypertrophy using proteome analysis. These results will show us how to improve muscle atrophy such as sarcopenia.

Methods: We made two different models; fish protein feeding model and treadmill training model. For fish protein-feeding model, the rats were throughout the seven-day feeding experiment with fish protein and casein. For treadmill training model, the mice were randomly assigned to one of the two experimental groups: sedentary control and training groups. The training group mice were subjected to chronic exercise on a treadmill for 60 min at 14–20 m/min, 5 days per week, for eight-week. After experiment, the animals were sacrificed, and the gastrocnemius muscle was excised. Gastrocnemius muscles were cut into pieces and homogenized after adding a lysis buffer to extract total protein. For comprehensive proteome analyses, we used iTRAQ-based systems, and western blotting analyses demonstrated to confirm the protein expression.

Results: We analyzed the total proteins extracted from muscle from both rats and mouse by LC-MS and detected and identified over 20,000 proteins based on the UniProt ID. To calculate the quantitative differences, we calculated the fold changes of the expressed proteins using isotope tags. Ingenuity pathway analysis was conducted to speculate the activated signaling pathways, and pathways related to the proliferation and differentiation of muscle cells were observed. Western blotting analyses clearly showed that suggested pathways were really changed.

Conclusions: Comprehensive proteome analyses demonstrated the upregulation of protein synthesis via protein kinase Akt/mTOR signaling in both models. Using this approach, we could speculate upstream molecules as well as protein expression differences. We would like to apply this approach for

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

screening of novel nutritional factors and/or pharmaceuticals to demonstrate the beneficial effects for skeletal muscles.

Keyword: skeletal muscle, hypertrophy, proteomics

Conflict of Interest Disclosure: This study was funded by Nippon Suisan Kaisha, Ltd. Eriko Yoshida and Kenji Uchida are current employees of Nippon Suisan Kaisha, Ltd.

PAB(T7-214)
Dual roles of protein hydrolysates from purple rice bran in early stages of carcinogens-induced liver and colon carcinogenesis in rats

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Background and objectives: Increased health awareness among consumers has supported the use of plant-protein hydrolysates to reduce the risk of degenerative diseases. The hydrolysate of purple rice bran glutelin exhibited antioxidant, antimutagenic and anti-inflammatory activities; however, there has been a lack of published studies on cancer prevention in animal experimtents. This study aimed to investigate cancer chemopreventive effects of glutelin and hydrolysates obtained during the production of purple rice bran protein hydrolysates in carcinogens-induced liver and colon carcinogenesis in rats and the relevant molecular mechanisms.

Methods: Defatted purple rice bran was soaked in NaOH to obtain an alkali soluble fraction that was further adjusted by pH to precipitate glutelin (GTL). The alkali soluble fraction and GTL were digested by alcalase under optimal conditions to obtain whole protein hydrolysate (WPH) and glutelin hydrolysate (GH) together with non-glutelin hydrolysate (NGH). All samples were spray-dried using maltodextrin as a carrier. Rats were injected with diethylnitrosamine, a hepatocarcinogen, and 1,2-dimethylhydrazine, a colorectal carcinogen, and orally administered GTL and various hydrolysates for 10 weeks. The end-point markers were hepatic GST-P positive foci and colonic aberrant crypt foci (ACF). Cell proliferation and apoptosis in the liver and colon were analyzed by immunohistochemistry. The expression of apoptotic and inflammatory genes was detected using Real-time PCR.

Results: Testers did not induce GST-P positive foci and ACF in the liver and colon of rats. Both GTL and GH could inhibit preneoplastic lesions in the liver and colon; however, only GH effectively suppressed colonic ACF. Interestingly, WPH and NGH promoted colonic ACF formation in carcinogen-initiated rats. GTL and GH decreased the number of PCNA positive cells, a cell proliferation marker, in liver and colon tissues. Moreover, GH increased the number of apoptotic hepatocytes and colonocytes and reduced inflammatory gene expression. WPH and NGH enhanced the expression of some proinflammatory cytokines, including IL-6, in carcinogen-treated rat colons.

Conclusion: Protein hydrolysate of purple rice bran contained both anticarcinogenic and carcinogenic peptides as protein sources. A specific protein, glutelin, could be the source of liver and colon cancer chemopreventive peptides.
Accordingly, the identification of these anticarcinogenic and carcinogenic peptides are now under investigation.

Keyword: Anticarcinogenicity, Cancer Chemoprevention, Glutelin, Protein hydrolysate, Purple rice bran.

PAB(T7-215)
Effect of theogallin on cognitive function in mice

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Background and objectives: Theogallin is an ingredient in green tea, but little is known about bioactivity. Therefore, we investigated the effect of theogallin on cognitive function in mice.

Methods: 64-week-old (aged) C57BL/6J mice were oral administrated using theogallin (10 mg/kg b.w.) daily for 7 days. Then, we evaluated cognitive ability using novel object recognition test. Effect of theogallin on hippocampal neurogenesis and neuroplasticity was assessed by western blot analysis to measure protein level of doublecortin (DCX), a stage-specific marker of adult neurogenesis, and cognition related proteins, such as early growth response 1 (EGR1), brain-derived neurotrophic factor (BDNF), and activity-regulated cytoskeleton-associated protein (Arc). Also, the expression of alzheimer's disease related proteins, beta-secretase 1 (BACE1) and phosphorylation of tau, was measured in hippocampus.

Results: Theogallin improved the cognitive function of old mice in the novel object recognition test, and up-regulated expression of hippocampal neuroplasticity-related proteins, such as BDNF, EGR1, and Arc. Interestingly, the expression of DCX was also upregulated in hippocampus. In addition, it downregulated the expression of BACE1 and phosphorylation of tau.

Conclusions: Taken together, our findings provide evidence for a novel effect of theogallin on cognitive function. Also, theogallin is considered to a beneficial ingredient that works for up-regulated proteins of cognitive ability, adult neurogenesis for neuronal precursors and migrating neuroblasts, and downregulated expression of alzheimer's disease related proteins.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-216)
Screening for inhibitors of lipid accumulation from Mango kernels.

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Backgroud and objectives: Obesity is defined as an excessive weight gain and abnormal fat accumulation, which is considered the major risk factor for chronic metabolic diseases such as type 2 diabetes. The obesity epidemic has paid attention to adipose tissue and the development of fat cells, termed adipogenesis. Therefore, control of adipogenesis accompanied by fat accumulation may prevent chronic metabolic diseases. In this study, we aimed to isolate anti-obesity agents from mango (*Mangifera indica L.)* kernels that inhibit intracellular lipid formation in 3T3-L1 adipocytes.

Methods: Effect of compounds isolated from mango kernels on lipid accumulation in 3T3-L1 adipocytes was evaluated by Oil Red O staining. cell viability was measured by MTT assay. Adipogenesis-, lipid synthesis-, and lipolysis- related gene were observed using RT-PCR and western blot.

Results: Ethyl gallate and ethyl digallate, 1,2,3,4,6-penta-O-galloyl-β-D-glucose (PGG) and 3-O-digalloyl-1,2,4,6-tetra-O-β-D-glucose (HGG) were isolated from mango kernels, and were obseved to be inhibited lipid accumulation regardless of the cytotoxicity. Furthermore, ethyl digallate, PGG, and HGG significantly suppressed the mRNA expression of adipogenic transcription factors such as C/EBPα and PPARγ. However, ethyl gallate did not affect the expression of these transcription factors.

Conclusions: Our findings reveal compounds present in mango kernels that inhibit lipid accumulation, thus providing potential therapy for obesity.

Keyword: 3T3-L1, obesity, mango seeds

PAB(T7-217)
The impact of pterostilbene on the interplay between epigenetics and metabolism in hepatocellular carcinoma

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Background and objectives: Disruption to metabolic status can lead to aberrant activity of epigenetic machinery and is often associated to diseases. In fact, many pieces of evidence indicate that epigenetic reprogramming are essential events in hepatocellular carcinoma (HCC), a primary liver cancer often implicated with disrupted metabolism. Interestingly, a dietary bioactive compound, pterostilbene (PTS), has been shown to restore disrupted metabolism in diseases by regulating activity of AMP-activated protein kinase (AMPK), a protein that monitors cellular energy. Relevantly, AMPK is often dysregulated in cancers and has previously been shown to negatively regulate gene silencing mediated by histone methylation, a form of epigenetic regulation. Herein, we investigated the effects PTS has in an *in-vivo* and *in-vitro* model of HCC and determined its impact on AMPK activity, histone modifications, and transcription of genes involved in carcinogenesis.

Methods and results: We incorporated PTS into a HCC-inducing diet and found significant attenuation in development of HCC in rats. Genome-wide transcriptional analysis on PTS supplemented rat livers revealed upregulation of several genes associated with tumor-supressing activities such as *Aldh1l1*, compared to the HCC-induced livers. *ALDH1L1* was also upregulated in PTS-treated HepG2 cells compared to control (ethanol), as we examined using quantitative reverse-transcription PCR (qRT-PCR). We quantified protein levels of active AMPK, and found that PTS significantly upregulated active phosphorylated form of AMPK. Due to the implication of AMPK in histone methylation, we then looked for changes in H3K27me3, a histone modification implicated in gene silencing, and H3K9ac, a marker of gene activation using chromatin immunoprecipitation followed by qPCR (qChIP). Remarkably, we found a significant decrease in H3K27me3 and an increase in H3K9ac marks at the promoter of ALDH1L1, implicating the open chromatin structure, which may, at least partially explain the upregulation of ALDH1L1.

Conclusion: PTS-induced activation of AMPK was correlated to changes in H3K27me3 and H3K9ac mark, accompanied by upregulation of ALDH1L1 in HCC. We will further investigate this relationship by quantifying changes to histone methylation in PTS-treated cells upon inhibition of AMPK.

Keyword: Polyphenols, Epigenetics, Bioactive compounds, Cancer, Metabolism

Conflict of Interest Disclosure: None

PAB(T7-218)
Effects of mannooligosaccharides derived from coffee on mineral absorption in ovariectomized rats

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Background and objectives: It has been reported that indigestible oligosaccharides have beneficial effects on the absorption of minerals and bone. Therefore, it was expected that mannooligosaccharides derived from coffee (MOS) has the same effect on mineral absorption as several oligosaccharides.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Furthermore, it has been reported that women are more prone to osteoporosis after menopause because of the decreased secretion of female hormones involved in bone metabolism. Therefore, we used ovariectomized rats as the osteoporosis model and investigated the effects of MOS on mineral absorption and bone mass in them.

Methods: This study was carried out with the approval of the Ethics Committee of Ajinomoto General Foods, Inc. Ovariectomized Sprague–Dawley rats (female, 4-week-old) were used and were fed a control diet and a 2.5% or 5% MOS containing diet *ad libitum* for 29 days. At 9–11 days and 27–29 days, mineral balance tests (Ca, Mg, and P) were performed. Every day, feces and urine were collected and weighed. Food intake, mineral content in the diet, and mineral excretion in feces and urine were used to calculate the apparent mineral absorption rate and retention rate. Weight, pH, and SCFA in the cecal contents were measured after the cecum was removed. Weight, ash weight, calcium content, and breaking energy were all assessed after the femur was removed.

Results: Mineral valance test: Ca and Mg absorption significantly increased in the 2.5% and 5% MOS group as compared with the control group ($p < 0.05$). Cecal contents: Content weight and SCFA in the cecum significantly increased in the 2.5 and 5.0% MOS group as compared with the control group ($p < 0.05$). pH in the cecum significantly decreased in the 2.5% and 5.0% groups as compared with the control group ($p < 0.05$). Bone: Bone weight and ash content were similar in the 2.5% and 5.0% MOS group as compared with the control group. Ca content was significantly higher in 5.0% MOS group ($p < 0.01$), and breaking energy was significantly higher in 2.5% MOS group ($p < 0.05$).

Conclusions: In ovariectomized rats, MOS consumption was beneficial in promoting mineral absorption.

Keyword: mannooligosaccharides, mineral absorption, ovariectomized rat

PAB(T7-219)
Seed peptide lunasin ameliorated inflammation and glucose uptake in 3T3-L1 adipocytes and C2C12 myotubes in the obese microenvironment

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Background and objectives: Obesity, a global health crisis, is manifested with impaired energy homeostasis and chronic low-grade inflammation. Food-derived proteins and peptides have been identified to have multiple bio-functions that alleviate diseases, including metabolic complications. Lunasin, a natural seed peptide, acts with multiple bioactivities, including anti-cancer, anti-inflammation, anti-oxidation, and immune regulation. This study aimed to investigate the effects of lunasin on inflammatory regulation and glucose utilization in C2C12 myotubes and 3T3-L1 adipocytes under obese condition.

Methods: Cells were treated with synthetic lunasin and lunasin-enriched soy protein isolate (LES) to compare the bioactivity of lunasin, C2C12 myotubes were stimulated by the palmate acid (PA) and 3T3-L1 adipocytes were stimulated by the tumor necrosis factor-α (TNF-α) to mimic the obese microenvironment.

Results: The results have shown that C2C12 myotubes treated with lunasin have lower monocyte chemoattractant protein-1 (MCP-1) and interleukin 6 (IL-6) secretions under the PA condition. In glucose utilization, lunasin improved glucose uptake and glucose consumption regardless of whether insulin was present or not. Lunasin increased glucose transporter 4 (GLUT4) expression in both spontaneous and PA condition without insulin present. In 3T3-L1 adipocytes, LES treatment has shown to increase glucose uptake in the spontaneous and TNF-α challenge with insulin conditions, but synthetic lunasin had no such effects.

Conclusions: These findings demonstrated that lunasin suppressed obesity-related inflammation and then ameliorated glucose update and GLUT4 expression, suggesting that lunasin is a promising regulator for glucose utilization in myotubes and adipocytes in the obese microenvironment.

Keyword: Lunasin, Adipocyte, Myotube, Inflammation, Glucose utilization

Conflict of Interest Disclosure: There is no conflict of interest.

PAB(T7-220)
The hemodynamics effect of single or repeated doses of cyanidin-3-glucoside

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Background and objectives: Cyanidin-3-glucoside(C3G) is one of the most abundant anthocyanidins in plants. Several intervention trials and subsequent meta-analyses have also suggested that anthocyanins reduce the risks of cardiovascular diseases. Ingestion of anthocyanidin shows the beneficial impact on the vascular system in general, but the relationship between the promotion of endothelium function induced by a single dose of anthocyanin and hypotensive activity induced by long-term ingestion of anthocyanin remain unclear. In the present study, we examined the impact of C3G on micro- or systemic circulation following a single or repeated dose .

Methods: (Single oral dose study) We examined the changes of cremaster muscle arterial blood flow by the method of laser doppler for 60 minutes following a single oral dose of vehicle or 1 mg/kg (C3G[1]). After the measuring period, the aorta was excised, we determined phosphorylation of Akt and endothelial nitric oxide synthase (eNOS) by the method of western blotting.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

(Repeated oral dose study) We measured the blood pressure by the tail cuff method following 14-days repeated gavage administration of 1 mg/kg C3G We measured the expression of eNOS in the aorta by the method of western blotting. In addition, we made frozen slice of soleus taken from the animals. We observed the expression of dapi, laminin, and CD31which is an angiogenesis marker by the method of immunohistochemically.

Results: (Single oral dose study) We observed the increase of blood flow soon after administration of C3G, and this change was continued during measurement period. The ratio of phosphorylated Akt were significantly increased taken 60 min after a single oral dose of C3G.
(Repeated oral dose study) Mean blood pressure was decreased on day 7 and day 14 after repeated administration of C3G, with slight increasing aortic eNOS level. The expression of CD31 in soleus were significantly increased by C3G with increasing cross-sectional area of soleus.

Conclusions: These results suggested the possibility that increased blood flow by an oral dose of C3G, resulting in the promotion of angiogenesis within skeletal muscle, consequently reducing blood pressure.

Keyword: Cyanidin 3-O-glucoside, hemodynamics, blood pressure, angiogenesis, cremaster muscle

1) Fushimi T, et al. Exp. Anim. 2021, 70, 372-377.

PAB(T7-221)
Induction of cell death by egg-derived sphingomyelin in rat hepatoma cells

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Background and objectives: Sphingomyelin (SPM) is one of amphiphilic sphingolipids which is composed of ceramide and phosphocholine. It is abundant in animal food products, such as eggs and milks. We have previously shown that egg-derived SPM induces cell death specifically in hepatoma cells, and that the mechanism of cell death is neither apoptosis nor necrosis. In this study, we aimed to clarify the details of the mechanism of cell death induced by SPM using rat ascites hepatoma cell AH109A.

Methods: Micellar egg-derived SPM was added to AH109A, and cell viability was measured by the WST-8 method. The intracellular reactive oxygen species (ROS) levels were examined by DCFH-DA. To confirm that SPM-induced cell death is a ferroptosis, the effects of ferroptosis inhibitors: Deferoxamine and Ferrostatine-1, were examined. Intracellular labile iron pool (LIP) level was also measured using Calcein-AM.

Results and Conclusions: Cell death was inhibited by simultaneous addition of α-Tocopherol with egg-derived SPM. Chelation of ferric iron with EDTA had no effect on cell death, whereas chelation of ferrous and ferric iron with deferoxamine inhibited cell death, suggesting that the chelation of ferrous iron may influence the cell death induced by egg-derived SPM. When ferrous or ferric iron was added, cell death was accelerated only for ferrous iron, suggesting the involvement of ferrous iron. In addition, cell death was inhibited by the ferroptosis inhibitors: Deferoxamine and Ferrostatine-1, and the lipid ROS level was increased by the addition of SPM, strongly suggesting that SPM-induced cell death may be a type of ferroptosis. Furthermore, comparison of intracellular LIP level between AH109A and other cells of which cell deaths were not induced by SPM revealed higher LIP level in AH109A, indicating the involvement of intracellular LIP level in SPM-induced cell death.

Keyword: sphingomyelin, ferroptosis, cell death, cancer, hepatoma

PAB(T7-222)
Anti-inflammatory effects of honeybush extracts and identification of effective ingredients

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Background and Objectives: We have been studying the health-promoting effects of honeybush (*Cyclopia subternata*), an herbal tea plant indigenous to South Africa. Previously, we had reported the anti-inflammatory effects of *C. subternata* extract in a UV-irradiated mouse model. In this study, *C. subternata* extracts and their fractions, were examined for their anti-inflammatory and skin-protective effects using Normal Human Dermal Fibroblasts (NHDF) and DNFB-induced dermatitis model mice. Fractionation was used in an attempt to enhance the anti-inflammatory activity.

Methods: NHDF were incubated with honeybush extracts or their fractions for 24 hours, whereafter IL-1β (1 ng/mL) was added to induce inflammation. Total RNAs were prepared and the expression levels of the inflammation-related genes, i.e., COX-2, IL-6 and MMP1, were measured by real-time PCR. *Cyclopia subternata* were extracted with hot water or 40% ethanol and an n-BuOH and an aqueous fraction was prepared by liquid-liquid fractionation. For in the *in vivo* study, hairless mice were divided into two groups: a DNFB-applied group and a non-applied control group, and a half of each group was orally treated with honeybush extract. We measured skin moisture content, TEWL and dermatitis symptoms, and assessed the histology of the skin.

Results and conclusion: The aqueous fraction of the honeybush extract inhibited the expression of COX-2 in NHDF, whereas the n-BuOH fraction showed a relatively weak inhibitory effect, suggestion that the aqueous fraction had a stronger anti-inflammatory activity than the n-BuOH fraction. In the *in vivo* study, inflammatory symptoms, epidermal thickening and dermatitis induced by DNFB were suppressed by both the aqueous and n-BuOH fraction of the honeybush extract. The aqueous fraction, but not the n-BuOH fraction, also significantly improved the skin moisture content. Both the *in vitro* and *in vivo*

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

results suggested that the aqueous fraction of honeybush had a relatively stronger skin protective effect than the n-BUOH fraction, so compounds contained in the aqueous fraction may have strong anti-inflammatory effect.

Keyword: Inflammation, Honeybush, Polyphenol, Dermatitis

PAB(T7-223)

The effect of collagen-derived dipeptide prolyl-hydroxyproline on chondrocytes under hypoxic conditions

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Background and objectives: Collagen peptides are used as functional food ingredients, and their effects on joints have been reported in recent years. It has been shown that collagen peptides inhibit differentiation into calcified cartilage, and the active body of collagen peptides has been found to be prolyl hydroxyproline (Pro-Hyp). Physiologically, there are no blood vessels in articular cartilage, and cartilage exists in a hypoxic environment. The effects of Pro-Hyp on hypoxic chondrocytes have not been clarified. This study examined the effect of Pro-Hyp on the hypoxia-mimetic state of the progenitor chondrocyte cell line ATDC5.

Methods: Cobalt chloride ($CoCl_2$) 200 µM and Pro-Hyp 0.001 mM to 1 mM were added to ATDC5 cells 24 hours after seeding, and the number of cells cultured for 24 and 48 hours was measured and used as an index of chondrocyte proliferation. ATDC5 cells were cultured with 200 µM of $CoCl_2$ and 0.01 mM to 1 mM of Pro-Hyp when cell density reached 100% confluency after seeding, ALP staining after 4 days of culture and Alcian blue (AB) staining after 12 days of culture were used as indicators of chondrocyte differentiation.

Results: Compared to the control group that only underwent medium exchange, the number of cells in both the $CoCl_2$ alone and $CoCl_2$ and Pro-Hyp simultaneously added groups decreased. Compared to the control group that only underwent medium exchange, $CoCl_2$ alone decreased ALP activity and AB staining area, while the simultaneous addition of $CoCl_2$ and Pro-Hyp inhibited the decrease in ALP activity and AB staining area in a Pro-Hyp concentration-dependent manner.

Conclusions: In this study, we found that the addition of Pro-Hyp suppressed the decrease in ALP activity and AB staining area in ATDC5 under hypoxia-mimetic conditions induced by $CoCl_2$, and that the addition of Pro-Hyp Pro-Hyp may maintain the differentiation of chondrocytes under hypoxic conditions.

Keyword: collagen peptide, prolyl-hydroxyproline, chondrocytes, hypoxia

PAB(T7-224)

Roasted whole-grain barnyard millet enriched diet attenuates metabolic syndrome-related risks in high-carbohydrate high-fat-fed rats

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Background and objectives: Obesity and metabolic syndrome have become major public health concerns, contributing to many comorbidities worldwide. Data showed that metabolic syndrome affects 20-25% of the adult population, globally. In combating obesity and metabolic syndrome, a lifestyle change that includes a healthy balanced diet is considered the most important initial step. Incorporation of functional foods in the diet is part of healthy dietary regimes in treating obesity and metabolic syndrome. Millet is one of the economically essential cereals that contain a high nutritional value that has the potential to give innumerable health benefits. Several studies indicated that barnyard millet contains a high source of protein including essential amino acids, carbohydrates, dietary fiber, polyphenols and micronutrients. However, there is a limited study that has highlighted the potential of whole barnyard millet consumption against metabolic syndrome. Thus, this study aimed to determine the effect of roasted whole-grain barnyard millet flour on metabolic parameters in rats with diet-induced metabolic syndrome.

Methods: Male Wistar rats (n = 7) were fed on a 10% addition of roasted whole-grain barnyard millet flour to a modified high-carbohydrate high-fat diet (HM) for the final eight weeks of a 16-week protocol. The control rats (n = 7) were fed with high-carbohydrate high-fat diet (HF) for 16 weeks. The rats were monitored for changes in adipose tissue mass, blood pressure, lipid profiles and histological hepatic structure.

Results: After 16 weeks of diet regime, the intervention rats' group HM showed significant differences ($P<0.05$) in adipose tissue mass, blood pressure, total cholesterol and triglycerides levels compared to the HF group. Decrement in the lipid droplet accumulation in the liver was also observed in HM rats compared to HF rats.

Conclusion: The results demonstrated that roasted whole-grain barnyard millet supplementation could be one of the potential functional foods, specifically in reversing metabolic syndrome disease.

Keyword: Barnyard millet, Metabolic syndrome, Blood pressure, Lipid profiles, Functional foods

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-225)
Identification and characterization of lipid-lowering peptides from oil palm kernel protein hydrolysate

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Background and objectives: Plant proteins play essential roles in human nutrition. Oil palm fruit is the most important oilseed crops globally where its kernel is obtained as waste after palm oil production. Our previous study demonstrated that oil palm kernel hydrolysate (OPKH) obtained after protease hydrolysis showed strong lipid-lowering properties by reducing apolipoprotein B100 (apoB100) secretion in HepG2 cells. Hence, this study aims to purify and identify the lipid-lowering peptides from OPKH.

Methods: First, the OPKH was purified by ultrafiltration, followed by reversed-phase (analytical) and semi-preparative HPLC to collect the bioactive peptide fractions. The effects of bioactive peptides isolated from OPKH protease hydrolysate on apolipoprotein B (apoB100) secretion was assessed using HepG2 cells as a model. Cell viability was measured using 3-(4,5-dimethylthiazol-2-yl)-5-(carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium (MTT) assay. Subsequently, cellular triglycerides (TG), cholesterol ester (CE) and apoB100 levels were determined using ELISA assay kits according to manufacturer's instructions. Next, the amino acid sequences of the lipid-lowering peptides were identified by ESI/MS/MS coupled with Q-TOF LC/MS and PEAKS studio software using de novo sequencing.

Results: Seven active fractions (F1-F7) were collected and purified from the oil palm kernel protease hydrolysate. Fraction F4 showed the highest lipid-lowering properties by reducing apoB100 secretion, cellular TG and CE levels. Fraction F4 was collected and re-chromatographed on the same analytical column where two sub-fractions (F4a and F4b) were obtained. Two lipid-lowering peptides, His-Phe-Asp-Ser-Ile (HFDSI) and Leu-Thr-Thr-Leu-Asp-Ser-Glu (LTTLDSE) were identified using LC-MS/MS. The molecular masses of the peptides, HFDSI and LTTLDSE were 618.25 and 777.37 Da, respectively. These bioactive peptides were not cytotoxic to HepG2 cells.

Conclusion: Bioactive peptides purified from the oil palm kernel protein hydrolysate demonstrates the potential as a nutraceutical to be utilized as lipid-lowering functional foods. Further in vivo studies will be conducted to verify the lipid-lowering properties of these bioactive peptides and the bioactive fractions.

Keyword: oil palm kernel protein hydrolysate (OPKH), lipid-lowering peptides, HepG2 cells, amino acid sequence, LC-MS/MS

Conflict of Interest Disclosure: There is no conflict of interests to be declared.

PAB(T7-226)
Effect of hot water extract of defatted perilla seed residue on bone metabolism

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Background and objectives: Perilla seed oil has many reported benefits as a health contributing food. However, most of the defatted perilla seed residue after oil extraction is disposed of as industrial waste. Recently, we found that perilla seed extract regulates bone metabolism by enhancing bone formation in osteoblasts and inhibiting bone resorption in osteoclasts. In this study, we explored the detailed mechanism of action in regulating bone metabolism in osteoclasts, and in addition, we examined the effect of perilla seed extract *in vivo* by the administration of it to osteoporosis model mice.

Methods: Samples were made by hot water extraction of defatted perilla seed residue and lyophilized. Osteoclasts were differentiation-induced bone marrow cells derived from mouse femur and tibia. The expression levels of various genes involved in osteoclastogenesis were measured and examined by qPCR. In addition, after creating an ovariectomized osteoporosis model mouse, the mice were orally administered extract of perilla seed daily. After 28 days of administration, the uterus and femur were harvested for uterus weight and dry bone weight measurements, as well as length measurements of trabecular bone structures.

Results: Defatted perilla seed hot water extract was found to significantly suppress the expression of downstream genes along with the suppression of NFATc1 gene expression. *In vivo* evaluation showed no significant increase in uterine weight in mice treated with perilla seed extract however, an increase in dry bone weight was confirmed. Furthermore, loss of trabecular bone area was observed after OVX treatment. But trabecular bone area inside the bone was significant recovery in mice treated with perilla seed extract.

Conclusions: Defatted perilla seed hot water extract does not exhibit estrogenic effects. However, it was found to be effective in reducing bone resorption ability by suppressing the expression of the NFATc1 gene expression, an essential factor for osteoclastogenesis. These functions suggest that perilla seed extract can ameliorate OVX-induced osteoporosis symptoms.

Keyword: Functional Foods and Various Diseases and Conditions, Bone Cartilage, Bone Metabolism

Conflict of Interest Disclosure: I have no financial relationships to disclose.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-227)
Quality characteristics of chicken stock with different plant ingredients

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This study was conducted for the purpose of improving the nutritional content and taste of chicken stock due to the addition of various plant materials. Apples, lemons and tomatoes were used as the main plant materials for chicken stock and 9 major nutrients were analyzed to examine changes in the nutritional composition of chicken stock. In order to evaluate the preference, sensory evaluation was performed using a five-point scale method. The crude protein content by Kjeldahl method was 2.53 g/100 g when apples were added alone (A), and 2.45 g/100 g when apples and tomatoes were added (AT). In contrast, the crude protein content of the apple, tomato and lemon (ATR) stock was 3.30 g/100 g. The crude protein content of ATR was increased by 134% compared to AT. As a result of analyzing the 9 major nutrients in the stock to which ATR was added, the crude protein content of the ATR-added group was 3.40 g/100 g, whereas that of the non-added group was 1.90 g/100 g, which increased by about 1.8 times. As a result of the amino acid analysis, the contents of glutamic acid, aspartic acid and various essential amino acids were increased in the group with the addition of ATR compared to the group without the addition of ATR. As a result of comparing with commercially available chicken stock using a five-point scale method for evaluation of preference, the ATR-added group showed the highest score in color, smell, and taste. In chicken stock, the addition of apple, tomato and lemon increased the content of various essential amino acids along with the increase of the crude protein content, and showed excellent results in terms of taste. Most commercially available products have high MSG and sodium content, but the chicken stock developed in this study is expected to be used as a health-oriented product that can replace existing products.

Keyword: chichen stock, plant ingredients, crude protein, sensory evaluation

PAB(T7-228)
Anti-inflammatory effects of RAW264.7 cells stimulated with lipopolysaccharide and antioxidant activities of *Terminalia ferdinandiana*

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Terminalia ferdinandiana (TF) contains various minerals and vitamins and is known as a fruit rich in phytochemical. In this study, the antioxidant activity of TF and its effect on the change in active free radical removal ability and IL-1β content in LAW264.7 cell were examined. In addition, after adding TF to foods such as beverages, yogurt, and salad dressing, sensory evaluation was conducted to explore the possibility of developing functional foods. As a result of measuring the DPPH radical scavenging ability, the activities of the hot water extract (TFH) and the ethanol extract (TFE) at 100 μg/ml concentration were 96.46% and 97.34%, respectively. In the SOD-like activity, when the concentration of TF extracts were 5 to 100 μg/ml, the activity was increased in a concentration-dependent manner. In particular, at a concentration of 100 μg/ml, the activity of each extract was 21.77% and 15.28%, respectively. In addition, ABTS radical scavenging activity, increased in a concentration-dependent manner when it was 5 to 100 μg/ml. Total polyphenol content of TFH and TFE showed a content of 30.96 mg/g and 224.48 mg/g, respectively. In the cytotoxicity test, 0 to 500μg/ml showed no toxicity. After LPS treatment on LAW264.7 cells, the ROS level was lowered in the group that added the TFH, indicating that TF had a protective effect from oxidative stress. Furthermore, the IL-1β content showed a significant increase compared to the LPS untreated group when LPS was treated, but the content IL-1β decreased when TFH was treated with 5 μg/ml and 100 μg/ml, indicating an anti-inflammatory effect. Sensory evaluation was conducted to examine whether there was a change in preference by adding TF to yogurt, powder yogurt, and dressing products. When 1.25 μg/ml of TF was added, there was no significant difference in taste and aroma compared to existing products. These results indicate that functionality can be improved without affecting existing foods, and the possibility of being used as an antioxidant material can be expected as it can be applied to various food developments in the future.

Keyword: Terminalia ferdinandiana, antioxidant activity, anti-inflammatory effect, RAW264.7 cells, sensory evaluation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-229)
Arousal inducing ability of procyanidin and caffeine, the difference to the mechanism of action

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Objectives: We have previously confirmed that following a single dose of cinnamtannin A2 (A2, epicatechin tetramer) activates neural activity in the mouse hypothalamus. It is known that sleep-active neurons located in the hypothalamus regulate the sleep-wake cycle. In this study, we compared arousal inducing ability between A2 and caffein in mice following a single oral dose.

Methods: After a 2-week habituation period, mice were orally administered A2(25 or 100 µg/kg) or caffeine (1, 100 mg/kg) and their behavior was observed for 180 min in an open field. Mouse behavior was analyzed in MATLAB using a program developed to quantify travel distance and time spent in central or corner area. We also observed noradrenaline levels in brain using by imaging mass spectrometry following a single oral administration 25 μg/kg A2. In addition, mRNA expression of noradrenalin synthase and transporter were detected using by *in situ* hybridization.

Results: While mice in the vehicle group showed sleep behavior after the exploratory period, mice in caffeine group exhibited a significant increase in travel distance to keep awake for 180 min. This result suggested that observation of spontaneous behavior in the open field can be evaluated to indirectly arousal. Caffeine increased travel distance dose-dependent manner. On the other hand, 25 µg/kg A2 group showed a significant increase in the spontaneous behavior, but this change disappeared in the 100 µg/kg group. Significant noradrenaline signals were observed in the locus coeruleus, brainstem, and hypothalamic preoptic area soon after A2 administration. While the expression of noradrenaline synthase and transporter mRNAs was only observed in the locus coeruleus. These results suggested that the feeding stimulus of A2 fires the locus coeruleus-noradrenaline system and projects noradrenaline to the sleep-active neuron in the preoptic area of the hypothalamus.

Conclusions: It is known that the locus coeruleus, the input site of A2, expresses not only promoting receptors but also inhibitory autoreceptors, the α2 adrenergic receptors (α2ARs). A high dose of A2 activates α2AR, consequently abolishing the promotion of arousal. The mechanism of A2 differs from that of caffeine, an adenosine receptor inhibitor.

Keyword: Epicatechin tetramer, Caffein, Arousal, Locus coeruleus

PAB(T7-230)
Transformation of major ginsenosides into minor ginsenosides in ginseng by pickling in salted rice malt paste

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Background and objectives: Production of minor ginsenosides from major ginsenosides in ginseng, the root of *Panax ginseng*, has been approached through using microbial and enzymatic reactions. However, these methods require commercial or self-purified major ginsenosides as a substrate, or culture medium or purified enzyme solutions. Therefore, they are limited by costs and the working process used for implementation. To enhance the contents of minor ginsenosides in ginseng at low labor and cost, fresh ginseng was pickled in a salted rice malt paste to transform major ginsenosides to minor ginsenosides.

Methods: Fresh 1-year-old and 6-year-old ginsengs were pickled in the salted rice malt paste fermented using *Aspergillus kawachii* in the dark at 23°C for 28 days. The pickled ginsengs were minced, homogenized in 80% ethanol, and incubated at 80°C for 14 h. The solution filtered and evaporated to remove ethanol was used as a ginseng extract.

Results: The extracts of 1-year-old and 6-year-old ginsengs pickled in the salted rice malt paste for 28 days contained minor ginsenosides F2 and CK in addition to major ginsenosides Rb1 and Rd by HPLC analysis. The ratios of Rb1, Rd, F2, and CK in the extracts of pickled 1-year-old and 6-year-old ginseng were, respectively, 40:39:7:14 and 35:45:8:12, whereas those in the extracts of fresh 1-year-old and 6-year-old ginseng were, respectively, 68:32:0:0 and 72:28:0:0. The respective amounts of F2 and CK in the 1-year-old ginseng pickled in the salted rice malt paste were 5.0 and 6.0 μg/g; those of pickled 6-year-old ginseng were, respectively, 3.0 and 2.0 μg/g.

Conclusions: Fresh 1-year-old and 6-year-old ginsengs, which had major ginsenosides Rb1 and Rd but had neither minor ginsenosides F2 and CK, were pickled in the salted rice malt paste with *A. kawachii*. The extracts showed production of F2 and CK, and changed the ratio of Rb1, Rd, F2, and CK in ginseng, demonstrating that pickling fresh ginseng in the salted rice malt paste is a simple and useful means of producing minor ginsenosides F2 and CK and changing the relative contents of ginsenosides in ginseng.

Keyword: Ginsenoside, Transformation, Salted rice malt paste, Compound K, beta-Glucosidase

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-231)

Elucidation of novel γ-oryzanol species in rice bran oil and processed foods containing rice bran oil

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Introduction: γ-Oryzanol (OZ) is a functional ingredient in rice bran. OZ in rice bran is mainly composed 24-methylenecycloartanyl ferulate (24MCA-FA), cycloartenyl ferulate, campesteryl ferulate, and β-sitosteryl ferulate. However, in the case of "rice bran oil" (RBO, a purified oil from rice bran), we found that the content of 24MCA-FA was low while two additional novels of OZ species were potentially detected. In this study, we focused more about the presence of two novel OZ species in RBO and determined their chemical structures. On top of that, the quantification of two novel OZ species and other OZ species in commercial RBO and processed foods cooked with RBO have been conducted.

Methods: Rice bran and RBO were analyzed by HPLC-UV-IT-TOF. The two novel OZ species were isolated from RBO using liquid–liquid extraction, flash-chromatography, and HPLC-UV with C18 column and C30 column. The structures of two novel OZ species were determined by NMR. Six kinds of commercial RBO and some processed foods cooked with RBO (potato chip and rice cracker) were analyzed using HPLC-UV-IT-TOF, and the amount of two novel OZ species and other OZ species were quantified.

Results and Discussions: In rice bran, only 24MCAFA was detected in the negative mode XIC of *m/z* 615.4429. In RBO, in addition to a small amount of 24MCAFA, two novel OZ species were detected as major peaks in the negative mode XIC of *m/z* 615.4429. NMR analysis revealed that the two novel OZ species isolated from RBO were cyclobranyl ferulate (CB-FA) and cyclosadyl ferulate (CS-FA). When the quantification of OZ species in commercial RBO and processed foods cooked with RBO was conducted, CB-FA and CS-FA, like other OZ species, were certainly contained in all RBO and processed foods. It was suggested that people might have often consumed CB-FA and CS-FA from RBO and/or processed foods.

Keyword: γ-Oryzanol, Rice bran oil, Rice bran, Processed foods containing rice bran oil

Reference: K. Sawada *et al.*,*Food Chemistry,* 337, 127956 (2021).

Conflict of Interest Disclosure: The authors declare the following financial interests/personal relationships that may be considered as potential competing interests: K. Sawada and H. Hashimoto are employees of a commercial company "Tsuno Food Industrial CO., LTD.". The company provided support in the form of remuneration for K. Sawada and H. Hashimoto but did not have any additional role in the study.

PAB(T7-232)

Effect of D-Serine intake in ataxia model mice

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Background and Objectives: We maintained an ataxia model mouse (Wob/t) with degeneration and shedding of cerebellar Purkinje cells, accompanied by intoxicated gait and tremor. Cerebellar atrophy of Wob/t is caused by degeneration and shedding of cerebellar Purkinje cells beginning ten days after birth. In recent years, D-amino acids have been detected in vivo and in particular, D-Serine has been reported to be important in NMDAR-mediated cerebellum development. Brain-derived neurotrophic factor (BDNF) is a secretory protein that affects the survival and development of neurons. Decreased BDNF expression in the cerebellum of individuals with SCA1 has been reported. Additionally, BDNF has been reported to increase with exercise and medication. Therefore, we researched the effect of D-Serine intake in ataxic model mice, particularly in relation to BDNF expression and gait.

Methods: Wob/t was divided into a D-Serine intake group (DS-Wob/t; n = 5) and a control group (Wob/t; n = 8). The time to fall in the rotarod test (2-20 rpm) was compared to evaluate gait. BDNF levels were measured in the cerebellum up to six months of age.

Results: There was a significant increase in the fall time in the rotarod test, between the control (35.7 ± 4.5 s) and the DS-Wob/t group (105.3 ± 6.3 s). BDNF expression levels in the cerebellum of the DS-Wob/t group were higher than the control group.

Conclusions: D-Serine intake improved coordination and enhanced BDNF levels in the cerebellum. Therefore, it is suggested that D-Serine may have delayed the progression of cerebellar pathology.

Keyword: Wob/t, Ataxia model mouse, D-Serine, BDNF

PAB(T7-233)

Effects of trigonelline on human renal glomerular endothelial cell function

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Background and objectives: Renal glomerulus, a bundle of capillaries lined by delicate fenestrated endothelia, plays an important role in urine production. Human renal glomerular endothelial cells (HRGECs) are the first barrier in ultrafiltration. HRGEC dysfunction causes glomerular diseases such as glomerulonephritis or glomerulosclerosis, ultimately leading to

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

kidney failure. Therefore, it is important to conduct research on the protection of HRGECs. While searching for various agricultural products that improve vascular function, we found Sakurajima daikon, a special product in Kagoshima prefecture, Japan. The functional compound contained in Sakurajima daikon was identified as trigonelline. We hypothesized that trigonelline may delay the progression of renal failure if it can improve the function of the renal glomerulus. We investigated the effects of trigonelline on vasoactive substances [vasodilator nitric oxide (NO) and vasoconstrictor endothelin-1 (ET-1)] in HRGECs.

Methods: The activation of endothelial NO synthase (eNOS) by phosphorylate of Ser1177 and expression of ET-1 in HRGECs were assessed by western blotting and flow cytometry. Bradykinin, acetylcholine, and vascular endothelial growth factor were used as positive controls. HRGECs were subsequently treated with trigonelline for specific time at various concentrations. The effects of trigonelline on the expression levels of phosphorylated eNOS and ET-1 were also investigated.

Results: The expression of phosphorylated eNOS and ET-1 in HRGECs was confirmed. The concentration- and time-dependent effects of trigonelline on eNOS activation were also confirmed. In addition, trigonelline effect on ET-1 production was evaluated.

Conclusions: Trigonelline tended to activate eNOS in HRGECs, suggesting that it increases NO production. Our study suggests that trigonelline protects glomerulus and prevents glomerular diseases. Further detailed studies are needed to understand and improve overall kidney function.

Keyword: Trigonelline, Nitric oxide synthase, Endothelin-1, Renal glomerular endothelial cells, Sakurajima daikon

PAB(T7-234)
Study on the functionality of the stem Tadeai(*Polygonum tinctorium* Lour:PTL)

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Background and objectives: Tokushima Prefecture ranks first in Japan in terms of Tadeai(indigo) cultivation area and yield. We have confirmed that rats treated with a 1%PTL leaf-added diet suppress weight gain, decrease intra-abdominal fat weight, decrease serum lipids, and PTL leaves have a preventive effect on lifestyle-related diseases. PTL is an annual plant, and leaves are used for dyeing and edible use. Half of the PTL cultivated is stems, stems are discarded every year. In this study, we examined the functionality of PTL stems in order to examine the utilization of discarded stems.

Methods: 12-weeks-old mature Wistar male rats were divided into 4 groups, AIN-93G was administered(Group C), and AIN-93G was supplemented with 5%PTL stem powder(Group S), AIN-93G with lard added to 30% fat diet(Group HF), 30% fat diet with 5%PTL stem powder added(Group HFS), each diet and water administered *ad libitum* for 6 weeks. One or two fresh feces were collected at 3 and 6 weeks after administration. On the day before sacrifice, only water was administered as a 24-hours fast, the abdomen was opened under anesthesia, blood was collected, and various components were measured using this serum. In addition, intra-abdominal fat, each organ, and the contents of the cecum were collected and the wet weight was measured. We analyzed and compared the intestinal or cecum bacterial flora.

Results: There were no differences in body weight change, food intake, organ weight between the each groups. Comparing serum triacylglycerols in group C and group S, it was significantly reduced by about 30% in group S. There was no difference in the intestinal flora in the cecum. Diversification of fecal bacterial flora by ingestion of stems which became more pronounced at 6 weeks of ingestion of PTL stem powder. Especially in group S, the intestinal flora of feces tended to resemble the cecum.

Conclusion: *Faecalibacterium*, which is expected as a next-generation probiotic, was present in the 6-weeks feces of some rats in group S, suggesting that PTL stem powder may function as a prebiotic.

Keyword: Intestinal bacterial flora, prebiotics, Tadeai

Conflict of Interest Disclosure: There is no conflict of interest in this abstract

Further Collaborators: There are no other collaborators

PAB(T7-235)
Ellagic Acid Prevents Binge Alcohol-Induced Leaky Gut and Liver Injury through Modulating Gut Microbiome Change

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Back Ground & Objectives: 1Alcoholic liver disease (ALD) is a major liver disease worldwide and can range from simple steatosis or inflammation to fibrosis/cirrhosis, possibly through leaky gut and systemic endotoxemia. We recently reported that a pharmacologically high dose of pomegranate extract prevented binge alcohol-induced gut leakiness and hepatic inflammation by suppressing oxidative and nitrative stress. Herein, we investigate whether a dietary antioxidant ellagic acid (EA) contained in many fruits, including pomegranate and vegetables, can protect against binge alcohol-induced leaky gut, endotoxemia, and liver inflammation.

Methods: 6-week-old female C57BL/6J mice were subjected to oral administration of a daily dose of 60 mg/kg EA, freshly prepared by suspension in water just before treatment, based on the calculation for physiologically and clinically relevant doses. Control mice were treated similarly by daily oral administrations with a vehicle. After EA pretreatment for 14 consecutive days, different groups of mice were exposed to 3 oral doses of binge alcohol or dextrose at 12 h intervals and euthanized 1 h after the last ethanol dose for collecting various tissues and plasma, the same as recently described.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Results: Pretreatment with EA significantly reduced the binge alcohol-induced gut barrier dysfunction, endotoxemia, and inflammatory liver injury in mice by inhibiting gut dysbiosis and the elevated oxidative stress and apoptosis marker proteins. Pretreatment with EA significantly prevented the decreased amounts of gut tight junction/adherent junction proteins and the elevated gut leakiness in alcohol-exposed mice.

Conclusion: Taken together, our results suggest that EA could be used as a dietary supplement for alcoholic hepatitis patients.

Keyword: binge alcohol, ellagic acid, gut microbiota, intestinal barrier dysfunction, endotoxemia

PAB(T7-236)
Exploring food-derived ingredients that up-regulate LDL receptor expression

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Background and objectives: Atherosclerotic cardiovascular disease is a major cause of morbidity and mortality worldwide. Elevated plasma low-density lipoprotein cholesterol (LDL-C) level is a prominent risk factor for atherosclerosis and coronary heart disease. The LDL receptor (LDLR) is a single transmembrane protein that is mainly expressed in the liver and is known to internalize LDL-C in the blood into cells. Therefore, increased expression of this protein is expected to reduce the risk of developing atherosclerosis. We have previously explored food-derived ingredients that up-regulate LDLR expression by luciferase reporter assays using the LDLR gene promoter region, and found several compounds including piperine and kaempferol (1, 2). In this study, we aimed to find functional ingredients that up-regulate the expression of LDLR from waste parts of agricultural products to add value to agricultural products and make effective use of them. After examining about 50 waste samples of agricultural products, we found that cherries (Sato Nishiki) axes contain ingredients that up-regulate LDLR gene promoter activity. Therefore, in this study, we focused on the axes of Sato Nishiki and aimed to identify the active ingredient.

Methods and Results: Sato Nishiki axes were extracted with 50% ethanol at 80°C for 1 hour, further separated using ethyl acetate and water, and the organic and aqueous layers were collected. The organic layer was further fractionated into a total of 100 fractions by reversed-phase HPLC fractionation, and fraction assays showed that some fractions were active. To isolate and identify the compounds in the fractions that were especially active, we performed by using HPLC, LC/MS, and NMR analyses. The results revealed that it is a glucoside of a certain flavone.

Conclusion: We have succeeded in identifying a compound that increases LDLR promoter activity in the Sato Nishiki axes. Analysis of the mechanism of its flavone-mediated LDLR up-regulation action is currently in progress.

Keyword: LDL receptor, food-derived ingredients, flavonoid

(1) PLOS ONE, 10, e0139799. (2015)
(2) Sci Rep, **6**, 24940. (2016)

PAB(T7-237)
Effect of enzyme-assisted extraction on nutritive value, bioactive compounds, and bioactive properties of date (*Phoenix dactylifera* L.) juices

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Background and objectives: Date palm (*Phoenix dactylifera* L.) has become an economical crop in Thailand. Date fruits of Barhi cultivar contain large amount of sugars and various bioactive compounds. Enzyme-assisted extraction is widely used to improve the quality and functional properties of fruit juices. This study aimed to compare the nutrients, bioactive compounds, and bioactive properties of date juices extracted without and with the aid of carbohydrases.

Methods: Deseeded Barhi date fruits were blended with water at 1:1 ratio. Juice extraction was performed at 45°C for 3 hours either with the aid of Pectinex® or Viscozyme® at the enzyme-to-substrate ratio of 1%, or without any enzyme. Nutritive value was analyzed according to AOAC Official Methods of Analysis. Total phenolic content (TPC) was determined using Folin-Ciocalteu method. Types and concentrations of phenolic acids, flavonoids and carotenoids were identified using HPLC. Antioxidant activities were assessed by DPPH, FRAP, and ORAC assays. Inhibitory activities on carbohydrate digestive enzymes were determined using *in vitro* calorimetric assays.

Results: Date juice obtained from enzyme-assisted extraction, particularly with Viscozyme, contained more moisture but less dietary fiber and sugars than that extracted without enzyme. TPC, DPPH, and FRAP values differed slightly among the three samples. Extraction with Viscozyme increased ORAC value of date juice from 585.31 to 913.26 µmol Trolox equivalent/100 mL. Enzyme-assisted extraction lowered the amounts of caffeic, syringic, p-coumaric, and synaptic acids but increased the amounts of ferulic and vanillic acids in date juice. For flavonoids, enzymatically extracted date juices contained more apigenin and isorhamnetin but less hesperidin, quercetin, and kaempferol. Carotenoids including lutein, α-carotene and β-carotene in date juices were unaffected by the application of enzyme. Enzyme-extracted date juices showed about five times greater inhibition of α-amylase than that extracted without enzyme, while the inhibitory effect on α-glucosidase were similar.

Conclusions: Enzyme-assisted extraction could be an alternative method to produce date juice with improved

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

antioxidant activities through ORAC assay, and strong antidiabetic properties through the inhibition of α-amylase.

Keyword: Dates, Enzyme-assisted extraction, Juice, Bioactive compounds, Antioxidant activities

Conflict of Interest Disclosure: The authors do not have conflict of interest to disclose.

PAB(T7-238)
Construction of a screening system for food compounds with anti-inflammatory effect to resore inflammation-induced suppression of UCP-1 expression in brwon-like adipocytes.

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Background and objectives: Obesity is the excessive accumulation of fat in adipose tissues. The adipocytes that compose adipose tissues are classified into three types: white, beige, and brown adipocytes, of which beige and brown adipocytes are called "brown-like adipocytes". Brown-like adipocytes are heat-producing cells that convert energy obtained by consuming stored fat into heat, and their activation is expected to lead to anti-obesity. Uncoupling protein-1 (UCP-1) is responsible for heat production in brown-like adipocytes, thus increasing UCP-1 expression leads to anti-obesity. On the other hand, chronic inflammation caused by obesity suppresses the UCP-1 expression, which means that heat production in brown-like adipocytes is suppressed under obese conditions. Therefore, it is expected that taking food compounds with anti-inflammatory effects will restore UCP-1 expression in brown-like adipocytes. Therefore, we attempted to develop a screening system for anti-inflammatory compounds with such restoration of UCP-1 expression.

Methods: It has been reported that LPS-activated macrophage culture supernatant (conditioned medium (CM)) suppresses UCP-1 expression. Thus, we attempted to construct a system to evaluate anti-inflammatory function of food compounds using CM. Mouse macrophages, RAW264.7 cells, were stimulated by LPS. The LPS-containing medium was replaced with fresh medium, and 24 hours later the medium was used as CM. Food compounds were added 24 hours before the replacement with fresh medium (still present during the LPS-stimulation). Twenty-four hours after the addition of the prepared CM to 10T1/2 adipocytes, UCP-1 expression was examined by quantitative RT-PCR.

Results: The activation of macrophages was evaluated by using gene expression of inflammatory cytokines as an indicator, and RAW264.7 macrophages were effectively activated by treatment with 1.0 mg/mL LPS for 3 hours. While control CM suppressed UCP-1 expression in 10T1/2 adipocytes, CM of anti-inflammatory food compound-treated RAW264.7 significantly restored the suppression of UCP-1 expression.

Conclusions: Some food ingredients with anti-inflammatory effects increase UCP1 expression at the basal level, thus it is difficult to evaluate only the recovery of UCP1 expression by anti-inflammatory effects. However, this CM-using system constructed in this study can evaluate only the anti-inflammatory effects on UCP-1 expression.

Keyword: Brown adipocyte, Beige adipocyte, Inflammation, Bioactive compound, UCP-1

PAB(T7-239)
Nutritional optimization and starch and protein digestibility of smart pasta made with gluten free African cereal and legume flours

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Background and objectives: Nowadays, malnutrition is a major public health issue. This reflects energy and macro and micronutrient imbalances. Among strategies to fight malnutrition, governmental food programs, fortification and nutritional optimization of staple food can be alternatively or concomitantly adopted. Pasta is one of the most popular staple foods. Traditionally made from wheat, its formulation has been improved by including legumes inside. The next effort for improving its formulation would be to use raw materials from climate-smart crops. Our study takes place in the European H2020 Innofood Africa project federating European and African countries on the development of climate-smart crops and their use in the context of a balanced diet. It aims to develop new nutritionally optimized pasta made from gluten free African raw materials adapted to the climate transition e.g. drought resistance, low input requirement.

Methods: Raw materials are cowpea, faba bean and bambara legume flours; teff, finger millet and amaranth cereal grain flours and additional nutritious raw materials such as orange fleshed sweet potato and amaranth leave flours. Nutritional and antinutritional composition of all flours were determined (protein, amino acids content, starch, sugar, fibres, vitamins, minerals, phytic acids, trypsin inhibitor). This constituted a data base for nutritional optimization of pasta by mathematical programming. In order to cover adults needs, the following criteria were selected: an amino acid chemical score above 110 taking into account process and cooking losses, an omega 6/omega 3 ratio closest to 5, a fiber quantity for 100g of pasta less than 25g, quantities of iron, zinc, B9 vitamin and beta carotene at less equal to recommendations and minimization of anti-nutritional factors.

Results: The best formulations covering the nutritional requirements, mainly based on cowpea, teff, amaranth leaves flours, have been selected. They were processed by a classical low temperature extrusion followed by a low temperature drying

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

preserving their nutritional qualities. They have been characterized and compared with classical 100% durum wheat semolina pasta for their textural and culinary properties and their nutritional composition. The *in vitro* protein and starch digestibility was carried out to determine the impact of formulations on the nutritional potential of pasta.

Conclusion: new nutritionally equilibrated, gluten free and smart for climat pasta have been obtained.

Keyword: sustainable food, nutritional optimization, pasta, extrusion

PAB(T7-240)
Mid-term effects of unpolished rice vinegar beverage consumption on oral flora and salivary proteins

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Background and objectives: Long-term (4 weeks or more) vinegar consumption has been reported to beneficial effects for obesity people to reduce body weight, body fat and serum triglycerides. On the other hand, long term vinegar consumption induced dental erosion. The transient vinegar intake (intake after 3-12 hour) has been reported to have oral clearance and antibacterial effects. In contrast, the mid-term (about intake over a week) effects are largely unknown. Based on previous findings, we hypothesize that medium term intake of acetic acid may activate the oral immune system and affect the secretion of antimicrobial proteins Therefore, we have investigated the effects at mid-term intake on the local oral immune response by analyzing salivary proteins and oral flora.

Methods: We used unpolished rice vinegar beverage (URVB) (750 mg acetic acid /500 ml) for vinegar intake group and water (bottled water) for control group. In URVB group (N=9, female undergraduate student), they took 250 ml URVB twice a day before a meal for one week. In control group (N=10, female undergraduate student), they took 250 ml water twice a day before a meal for one week. The saliva was collected at 0, 1, 3, 5, 7 days after start of administration. The sampling was performed just before URVB or water intake at dinner time. For 16S rRNA amplicon sequencing, DNA was extracted from 500 ul saliva and 5 ng of DNA was used for PCR. For Shotgun proteomics, 10 ug of saliva protein was used.

Results: Analysis of the saliva flora 0, 1, and 7 days during URVB intake showed a difference between 0 and 7 days in chao1 and observed futures ($P<0.05$), and no difference was observed between 0 and 1 day. Furthermore, clostridia bacteria were decreased at 7days in class level. As a same, *clostridiales* and *rhodobacterales* bacteria were decreased at 7 days in order level. On the other hands, *bacillales* bacteria were increased at 7 days in order level.

Conclusions: One week of continuous URVB intake affected salivary bacterial flora, suggesting that mid-term intake acetic acid modulates oral responses.

PAB(T7-241)
Safety Evaluation and Chondroprotective Functionality of *Salviae plebeia*

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Backgroud and objectives: Salviae Plebeia (SP) contains numberous chemical components and is reported to exert various pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial, analgesic, hypoglycemic, antiviral, anti-tumor, and hepatoprotective effects. Even though it has these various effects, its scientific proof remains uncertain the effect and underlying mechanism about joint damage. Accordingly, the present study was designed to evaluate the therapeutic effects and possible underlying mechanism of SP on osteoarthritis (OA).

Methods: OA animal model was induced via intra-joint injection of monosodium iodoacetate (MIA) 50 uL with 80 mg/mL in SD rat. Excluding the normal group, OA-induced mice were divided into 4 groups (control, INDO, SPL, SPH). The drug concentrations were indomethacin 5 mg/kg, SP 500 mg/kg, and SP 1,000 mg/kg, and were administered orally once a day for 2 weeks. After drug supplementation, the effects of SP were measured with serum analysis, western blotting, and histopathological staining.

Results: SP administration improved hind limb overload and it led to relieve pain. Moreover, it suppressed oxidative related factors. The NF-κB inactivation though the inhibition of IκBα phosphorlyation significantly decreased both inflammatory mediators such as COX-2 and iNOS and cytokines such as TNF-α, IL-1β, and IL-6. Whereas, anti-inflammatory cytokines like IL-4 and IL-10 were shown to increase. In addition, SP administration exerted a protective effect on ECM by reducing the expression of collagen degradation factors including MMP-1, -3, -13 and by increasing TIMP-1.

Conclusions: SP may possess the effect of delaying the progression of osteoarthritis and protecting cartilage. Accordingly, the present study may provide a scientific basis the chondroprotective effect of SP on MIA induced osteoarthritis.

Keyword: Chondroprotection, Satety, Functionality, Salviae plebeia

Conflict of Interest Disclosure: We have no Conflict of Interest Disclosure

Further Collaborators: This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ015272042022)" Rural Development Administration, Republic of Korea.

PAB(T7-242)
Effects of Ascorbic acid on bone metabolic indicators in vitro and in vivo

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L-ascorbic acid (AsA) is known to affect bone formation by participating in collagen synthesis in animals. Osteoporosis is caused by collagen loss which is reversible. This study was intended to examine the effect of AsA on bone formation in cellular and animal models by analyzing bone metabolic indicators.

As osteoblasts, MC3T3-E1 cells were used and cultured with various concentrations of AsA during the cell differentiation period. To examine the effect of AsA on bone formation, ALP activity and bone calcification assays were performed. In addition, the effect of AsA on the expression of osteoblast differentiation-related proteins was also examined. In animal experiments, ovariectomy was performed to induce bone loss, and AsA was administered for 7 weeks. ALP activity and CTx and NTx Ⅰ content in serum were measured. The content of collagen in bone and cartilage were analyzed.

AsA treated cells showed a significant increase in ALP activity, an early indicator of bone calcification, compared to the control group. ASA promoted mineralization, which is a late stage of osteoblast differentiation. In addition, AsA increased the expression levels of collagen I and the expression of ALP and RUNX2 was increased by treatment with AsA 10μg/ml, and the expression of BSP and OPN was also increased. In ovariectomized animals, ALP, an indicator of bone formation, increased by ASA administration, but concentrations of CTx and NTx, indicators of bone resorption, decreased. The collagen content was increased in the AsA-administered groups compared to control group. From the above results, it was found that AsA has the effect of promoting factors related to bone formation and reducing factors related to bone resorption. These results indicate that it can be used as a material that can alleviate symptoms such as osteoporosis in the future.

Keyword: ascorbic acid, bone formation, bone resorption, osteoblast, ovariecotomized

PAB(T7-243)
Docosahexaenoic acid-containing diets inhibits decline kidney functions by reducing oxidative stress and inflammation at early stage of chronic kidney disease on 5/6 nephrectomized rats

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Background and objects: The kidneys are responsible for excretion of metabolites, maintenance of pH, adjustment of blood pressure, and regulation of body fluid volume. Therefore, it is very important to keep kidney functions. Arachidonic acid (ARA), an ω-6 polyunsaturated fatty acid (PUFAs), is involved in development and maintenance of the renal function. Docosahexaenoic acid (DHA), an ω-3 PUFAs, has anti-inflammatory effects. Previous study, increasing urinary albumin excretion 16 weeks after nephrectomy, it was attenuated by ARA or/and DHA containing diet fed 5/6 nephrectomized rats. The purpose of our study was to assess the effects of PUFAs on the early stage of chronic kidney disease (CKD).

Method: Male Sprague Dawley were randomly divided into Control group, ARA group, DHA group, and ARA+DHA group. Rats were removed 5/6 kidney and they were feed continuous for 4 weeks. rats were removed 5/6 kidney and they were feed continuous. Rats were housed in individual metabolic cage and were collected urine for 24 hours. 4 weeks after surgery, plasma and kidneys were collected for biochemical and histological analysis.

Results: Indoxyl sulfate (IS), one of the causes of uremia, reactive oxygen species (ROS), and tumor necrosis factor – α (TNFα) as inflammation cytokine in kidney were increased by nephrectomy, it was attenuated by feeding DHA containing diet. ROS and TNFα levels in the kidney at 4 weeks significantly negative correlated with creatine clearance; positive correlated with urinary albumin levels. The cause of albumin excretion in urine is glomerular damages. Histological analysis revealed that vacuolization of kidney tissue, proliferation of mesangial cells, and growth of mesangial substrates such as glomerular damages were increased in kidney section 4 weeks after nephrectomy. These damages were attenuated by DHA containing diet.

Conclusion: These results suggest that the DHA diets inhibits progress the early stage of CKD by decreasing oxidative stress and inflammation.

Keyword: 4-HDHA, 18-HEPE, peroxynitrate, TGFβ1, α-SMA

Conflict of Interest Disclosure: There is no conflict of interests in this study.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-244)
Effect of omega-3 fatty acid supplementation on sleep quality in healthy subjects.

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Background and objectives: Omega-3 fatty acids have various functions, and one of these functions, an effect of sleep quality, has recently been shown to be effective in clinical studies. In some meta-analyses for children, omega-3 fatty acid could have the benefit of improving sleep quality. It is said that affected by aging for over 45 years old, the actual time of sleep is shorter. This study investigated the effect of omega-3 fatty acids on improving sleep quality in subjects aged 45 years or older, whose sleep quality is deteriorating.

Methods: This study conducted a randomized placebo-controlled, double-blind, parallel groups design. 66 healthy Japanese men and women were randomly assigned to receive 0.48g X 6 capsules per day of omega-3 fatty acid (DHA 576 mg, EPA 284 mg per day, omega-3 group, n=33) or corn oil (control group, n=33) for 12 weeks. Before and after intervention, the OSA sleep inventory MA version (OSA-MA) and sleep quality test using a sleep scanning mat device were conducted.

Result: In omega-3 group, factor Ⅲ (frequency dreaming) scores in the OSA-MA significantly improved compared to control group. And sleep efficiency from sleep quality tests was also high compared to control group.

Conclusions: It was found for the first time that omega-3 fatty acids have the benefit of the sleep quality in only middle-aged and older subjects, and even at lower doses than those found in the previous study. Further investigation about mechanisms of improving sleep quality by taking omega-3 fatty acids are required.

Conflict of Interest Disclosure: This research was conducted with a research fund from Nippon Suisan Kaisha, Ltd., which the author belongs to.

Keyword: omega-3 fatty acid, docosahexaenoic acid, sleep quality

PAB(T7-245)
Homocarnosine as a novel food factor increases brain GABA and homocarnosine levels

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Background: Gamma-aminobutyric acid (GABA) is an important neurotransmitter. Dysregulation of brain GABA levels links to depression-anxiety behaviors and brain diseases such as epilepsy and Alzheimer's disease. Recently, various GABA-rich foods and supplements have been developed for ameliorating those neurological disorders. In addition to GABA, a GABA-containing peptide homocarnosine (GABA-L-histidine) is found at high concentrations in the brain and its biological antioxidant effect has been expected. Therefore, we proposed that homocarnosine can be a potential functional food for increasing brain GABA and homocarnosine. However, this hypothesis is challenging because there are unclear points regarding homocarnosine supplementation such as blood stability and permeability across the blood-brain barrier.

Objective: To determine if oral homocarnosine administration can increase GABA and homocarnosine levels in blood and the brain.

Methods and Results: ICR mice were orally given homocarnosine (2.12 g/kg body weight) through gavage method for 4 weeks. Carnosine and GABA as the homocarnosine derivative and substrate, respectively, were used as comparisons. Peptide and amino acid levels in plasma and brain were measured by using liquid chromatography-mass spectrometry. As expected, in the control group, GABA was present in trace amount (0.18 ± 0.06 µM), while homocarnosine was not detected. By giving orally homocarnosine, GABA, and carnosine, plasma GABA was significantly increased (0.33 ± 0.10, 0.40 ± 0.09, and 0.30 µM ± 0.09, respectively, vs. control, P< 0.05). However, only homocarnosine administration could significantly increase brain GABA levels (1.33 ± 0.08 (control) vs. 1.67 ± 0.28 µmol/g, P = 0.016). Both homocarnosine and carnosine administrations significantly increased its own levels in the brain (230 ± 66 (control) vs. 500 ± 114 (homocarnosine) nmol/g, P = 0.0003 and 103 ± 35 (control) vs. 156 ± 36 (carnosine) nmol/g, P = 0.021). GABA administration significantly increased brain homocarnosine levels (230 ± 66 (control) vs. 384 ± 47 nmol/g, P = 0.0009), but not carnosine levels.

Conclusion: This study demonstrates that oral homocarnosine administration can increase GABA and homocarnosine levels in both blood and the brain. The finding will lead to the development of nutritional interventions for increasing brain GABA and homocarnosine for promoting brain health.

Keyword: homocarnosine, GABA, brain, carnosine, oral administration

Conflict of Interest Disclosure: There is no conflict of interest.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-246)

The effects of lactate treatment on neuronal differentiation and gene expression profiles in human and mouse neuroblastoma cell lines.

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Background and objectives: Lactate serves as the major glucose alternative and adequate energy supply in brain and involved in neuronal functions including neuroplasticity and memory consolidation. Lactate is accumulated in fetal brain during gestational stage, indicating the key roles of lactate for brain development and neuronal differentiation. Recent reports show that lactate functions as a signaling molecule to regulate gene expression and protein stability. However, the roles of lactate signaling in neuronal cells remains unknown.

Methods: Here, we investigated the effects of lactate on neuronal differentiation of mouse and human neuroblastoma cells. SH-SY5Y cells, a human neuroblastoma cell line, were induced to differentiate by retinoic acid with or without 30 mM lactate for 1-6 days. RNA-seq was performed in lactate-treated SH-SY5Y and Neuro2a, mouse neuroblastoma cell line.

Results: Intracellular concentration of lactate was significantly increased by lactate supplementation. 30 mM Glucose treatment did not affect intracellular lactate levels. Lactate stimulation promoted the neuronal differentiation characterized by neurofilament-H and beta-tubulin 3 positive area, length and continuous growth rates of neurites outgrowth at day 4 and 6, and increased protein expression of neuronal maker including neuron specific enolase at day 17. NDRG family member 3 (NDRG3), a lactate-stabilized protein against proteasomal degradation, was highly expressed by lactate treatment. We found 900 differentially expressed genes (DEGs) between lactate-treated and untreated SH-SY5Y and 6447 DEGs between lactate-treated and untreated Neuro2A. Scatter plot analysis showed a good correlation of SH-SY5Y and Neuro2A (correlation coefficient r=4.14). Over representation analysis of the highly ranked human-mouse gene pairs showed the pathways upregulated by lactate treatment including extracellular matrix organization, integrin cell surface interactions, hemostasis, neutrophil degranulation and response to elevated platelet cytosolic calcium. The pathways downregulated by lactate treatment including eukaryotic translation initiation, response of eIF-2-alpha kinase (GCN2) to amino acid deficiency, selenoamino acid metabolism, regulation of expression of slits and Roundabouts, signal recognition particle dependent co-translation protein targeting to membrane. Furthermore, neuronal system pathway was also significantly upregulated in lactate-stimulated SH-SY5Y and Neuro2a.

Conclusions: Our study demonstrates the promotive effects of neuronal cell differentiation and multiple regulatory roles in neural function of human and mouse neuroblastoma cells.

Keyword: lactate, neurogenesis, neuronal plasticity, neuronal differentiation, nervous system

PAB(T7-247)

Effect of red bean paste intake on the maintenance of instantaneous power and endurance during exercise of university student athletes.

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Background and Objectives: The components of red bean paste are specialized for carbohydrate. Accordingly, people who play sports such as marathon take red bean paste to supplement carbohydrate during exercise. Therefore, we investigated the effect of red bean paste intake on the maintenance of instantaneous power and endurance during exercise among university student athletes.

Methods: The red bean paste contained energy; 100 kcal, prptein;1.3 g, fat; 0.1 g, carbohydrate; 24.0g and salt; 0.15g respectively, per 55g of packet. University student athletes were ingested the red bean paste at the beginning or end of exercise load. In the physical data measurement, the instantaneous force was measured by repeated side jumps, and the endurance was measured by a 20m shuttle run (round-trip endurance running). The blood glucose level was measured using a self-monitoring device.

Results: Intake of red bean paste in the beginning of exercise, their instantaneous power and endurance remained unchanged. However, intake of this paste in the end of exercise, which had a significant effect of endurance. A group which was less than 95 times in shuttle run was significant increase in the times of shuttle run, and blood glucose levels was increased. When red bean paste was ingested, the peak blood glucose level was slower and the concentration was lower than that of sugar solution.

Conclusions: During exercise, sugar consumption becomes active and the blood glucose level drops faster, so by taking red bean paste about 10 minutes before the endurance declines due to fatigue. It is thought that sugar is supplemented and the blood glucose level rises, which is expected to improve endurance. In addition, since the rise in blood glucose level is milder than that in sugar solution drinks containing white sugar, high-concentration sugar is used without raising the blood glucose level to a level that causes insulin shock due to the effects of dietary fiber and polyphenols contained in red bean paste. It was suggested that red bean paste could be taken.

Keyword: red bean paste, plasma glucose, glucose metabolism, instantaneous power, endurance

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-248)

Protein-energy nutritional status of moderately low protein intake-sago diets compared to sufficiently protein intake-rice diets in well-nourished lowlanders in Papua, Indonesia

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Background and objectves: Protein inadequacy is prevalent in developing countries because of the high consumption of starchy staple foods. Sago, as a staple food in Papua Province, was eaten with less protein. This study aimed to analyze the nutritional status of protein-energy in well-nourished adults of the moderately low protein in-take (MLP)-sago group compared to the sufficient protein intake (SP)-rice group, in lowland Mimika, Papua.

Methods: This cross-sectional-analytic study was conducted on 50 participants. Twenty-four-hour food recall, body composition, albumin, and complete blood count were used to assess the nutritional status. Results: There were no differences in the body compositions and albumin levels between the MLP-sago and SP-rice groups. Multivariate linear regression showed that the mean corpuscular volume (MCV) (β = -0.524, *P* = 0.007) was a predictive factor for albumin in the sago group, while in the rice group, hemoglobin (β = 0.354 *P* = 0.089) and white blood cell counts (β = 0.396, P = 0.059) were predictive factors.

Conclusions: The MLP-sago and SP-rice groups exhibited no differences in the body and visceral protein; however different predictors of albumin were found be- tween the groups, suggesting an adaptive mechanism in the MLP-sago group to maintain normal albumin levels.

Keyword: Protein intake, Sago, Papua, Indonesia, MCV

PAB(T7-249)

Hepatoprotecive effects of *Lycium barbarum leave's* ethanol extracts in non-alcoholic fatty liver disease models and HepG2 cell

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Background and objectives: The purpose of this study was to explore the efficacy of the material to develop a food material for the treatment of NAFLD usingan animal model of non-alcoholic fatty liver disease (NAFLD).

Methods: The material used in the experiment was extract of *Lycium barbarum's* leaves (LBL) with chlorophyll removal. This material has also been reported to have excellent anti-oxidant and anti-microbial activity in our previous study. In this study, we estimated the anti- fatty liver disease effect of LBL in NAFLD animal model and in HepG2 cell induced trilyceride accumulation with palmitate.

Results: There was no difference in serum TG and total cholesterol concentrations, and ALT and AST activities were significantly decreased compared to the control group. Compared to the liver tissue of the control group, the size and number of fat cells were significantly decreased in the LBL-treated group. Both TG and TC contents of liver tissue were significantly decreased in the LBL-treated group compared to the control group. As a result of WST assay measurement in HepG2 cells, toxicity was not observed up to a concentration of 1000 μg/mL. As a result of ORO staining, compared with the control group, fat accumulation was reduced in a concentration-dependent manner in the LBL group. It had a concentration-dependent effect and showed anti-fatty liver efficacy.

Conclusions: The ethanol extract of *Lycium barbarum*'s leaves from which chlorophyll has been removed appears to have anti-fatty liver efficacy, and the potential for development as a functional material was confirmed.

Keyword: *Lycium barbarum*'s leaf, Hepatoprotecive effects , non-alcoholic fatty liver disease

Acknowledgment: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2017R1D1A3B03028628)

PAB(T7-250)

Adenosine Derivatives-Enriched Cordyceps militaris Extract Shows ENT1-mediated Transport and Induces Autophagic Cell Death via AMPK-mTOR Signaling Pathway

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Background and objectives: Cordyceps militaris Extract (CME) is mainly composed of adenosine derivatives, including 3'-deoxyadenosine, as known as cordycepin. The cytotoxic effects of CME and cordycepin have been reported, but the underlying molecular mechanism is yet clear. In this study, we analyzed the molecular mechanism of CME and cordycepin to have their cytotoxic effects in vitro and vivo.

Methods: Human ovarian cancer cells (A2780, SKOV3, OVCAR3, and TOV112D) were treated with CME or cordycepin for 48 h to perform three separate viability assays. To evaluate

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

the cytotoxic effect of CME and cordycepin in vivo, BALB/c nude mice were injected subcutaneously in the back next to the right hind leg with A2780 cells. A low and high dose of CME, cordycepin (25 mg/kg) or PBS were intraperitoneally injected for 12 days. Candidate macromolecular targets of adenosine derivatives (cordycepin and N-(2-hydroxyethyl)adenosine) in CME were predicted using the SwissTargetPrediction tool. Cellular signaling pathways were observed by docking experiments and signal transduction proteins with nitrobenzylthioinosine (NBTI), SCH 58261, PSB 603, Compound C, and 5-Iodotubercidin (5'-ITU). The relevance of potential targets to ovarian cancer was explored using publicly available web-based data (cBioPortal and Human Protein Alas).

Results: CME and cordycepin treatments effectively resulted in cancer cell death by showing significant reduction of cell viability and tumor sizes in xenograft mice. Inhibition of ENT1 suppressed the cell death, while that of Adenosine receptor 2A and 2B did not alter cell viability regardless of their effects on cAMP production. The results suggested that functional ENT1 transporting CME and cordycepin into the cytosol was required for effects of CME and cordycepin. The uptaken CME and cordycepin increased phospho-AMPK and inhibited mTOR activity, and subsequently led to autophagic cell death. Inhibition of AMPK reversed effects of CME and cordycepin on cell viability, indicating that AMPK activation mediated CME and cordycepin effects. According to the in-silico data, AMPK β and γ subunit genes among the seven AMPK subunit genes showed significant correlation between survival probability and mRNA expression level in cancer patients.

Conclusions: Our data suggest that adenosine derivatives may be an effective therapeutic intervention through ENT1-AMPK-mTOR.

Keyword: Cordyceps militaris, Adenosine derivatives, ENT1, AMPK, Ovarian cancer

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T7-251)
Effect of a ginger-containing beverage on peripheral circulation and cold sensitivity in healthy subjects

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Background and objectives: Various functional foods such as ginger are expected to improve peripheral circulation. One of the Japanese beverages made from wine vinegar, ginger juice, and molasses is also used as a seasoning. We examined the effects of two weeks of drinking this product on peripheral circulation.

Methods: Sixteen healthy participants (age, 64.8 ± 13.0 y: 2 males and 14 females) were recruited. They were required to drink a ginger-containing drink daily for 14 days. The following experiments were performed on days 1 and 14. Capillaries were observed near the nail matrix of the index finger of the hand using capillary microscope (SC-10, At co., Ltd, Osaka). Associated analysis software was used to examine the number, length, thickness, and clouding of capillaries. On the scheduled date, changes in skin temperature of the back of hands and index finger tips were assessed 20 minutes after drinking beverage using Thermography camera (FLIR E85, Teledyne FLIR LLC, U.S.A). Taste preferences such as bitter, sweet, salty, sour and umami were evaluated after 14days. We also used a self-administered questionnaire to ask about peripheral coldness and numbness.

Results: The most highly rated taste was sourness, followed by umami and sweetness. In the observed field of view, the capillary microscope showed an increase average number of capillaries and their total length. In 4 of the 14 evaluable cases (28.6%), the number of sites with elevated peripheral skin temperatures increased after 14 days. According to the questionnaire survey, both peripheral coldness and numbness were evaluated better after drinking.

Conclusion: Drinking tested beverage made from wine vinegar, ginger juice, and molasses for 14 days may contribute to improved peripheral circulation and cold sensitivity.

Keyword: Ginger, Peripheral circulation, Capillary microscope, Thermography, Sensory evaluation

PAB(T7-252)
Anti-allergic effect of onopordopicrin containing Japanese leaf burdock

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Background and objectives: Japanese leaf burdock *Arctium lappa* is a one of specialty vegetables at Osaka. The stems and leaves of Japanese leaf burdock are edible and are often fried (Kakiage), sauteed and simmered. Japanese leaf burdock has a strong anti-allergic effect. Furthermore, we revealed that the anti-allergic compound in Japanese leaf burdock was onopordopicrin (OPP). OPP is classified as the sesquiterpeneoid germacranolide and has some functions such as anti-ulcerogenic, anti-inflammatory, anti-bacterial and anti-proliferative activities. We investigated the anti-allergic mechanism of OPP.

Methods: The leaves of Japanese leaf burdock were freeze-dried and extracted with 70% ethanol. The extract was fractionated by the ethanol stepwise (10%, 20%, 40% and 80%) method using an HP-20 column. Moreover, the 80% ethanol eluted fraction was refined by preparative thin-layer chromatography and high-performance liquid chromatography due to purify OPP. The suppression of degranulation after the allergen stimulation and the Ca^{2+} ionophore (A23187) were evaluated by the inhibition of β-hexosaminidase releases in a rat

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

basophil leukemia cell which could initiate IgE–FcεRI interactions and subsequently induce a model reaction of type I allergic responses. Moreover, after the allergen stimulation, the inhibition of Ca^{2+} influx into cells and the suppression of inflammatory mediator releases were measured.

Results: The purified OPP elicited a concentration-dependent inhibition of degranulation after the allergen stimulation. Furthermore, the degranulation by A23187 also were suppressed by the purified OPP. However, the purified OPP did not inhibit the Ca^{2+} influx into cells after the allergen stimulation. The supernatant concentrations of tumor necrosis factor-α, prostaglandin D_2, and leukotriene B_4 after the allergen stimulation in the purified OPP were lower than those in a control.

Conclusions: Future, we'll clarify the effect of OPP to the intracellular signal transduction after an allergic reaction.

Keyword: antiallergic components, onopordopicrin, RBL-2H3 cell

PAB(T7-253)
Epigallocatechin gallate enhances ghrelin secretion from the gastrointestinal tract and increases NPY gene expression in the hypothalamus

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Background and objectives: Epigallocatechin gallate (EGCG) is a catechin (natural polyphenol) found in green tea that has many biological functions; some studies have shown that EGCG suppresses feeding and reduces body weight in mice and rats. However, there are no detailed studies on the effects of EGCG on peripheral feeding-regulating hormone release. Therefore, we examined how EGCG affects the release of peripheral feeding-regulating peptides.

Methods: C57BL/6j mice were used as experimental animals, and 200 μg of EGCG was administered intraperitoneally. Blood was collected from the tail vein 20, 60, and 180 min after administration. Plasma concentrations of insulin, leptin, cholecystokinin, and ghrelin were measured by enzyme immunoassay. The hypothalamus was removed from the brain and gene expression of NPY and POMC were measured by real-time RT-PCR. In addition, the direct effects of EGCG on cholecystokinin and ghrelin secretion were examined by gastrointestinal perfusion.

Results: Plasma cholecystokinin and ghrelin concentrations were significantly reduced and increased, respectively, by EGCG compared to controls, but there were no differences in plasma insulin and leptin between the groups. Hypothalamic NPY mRNA level was increased 2-fold by EGCG, but POMC mRNA level was not altered. In gastrointestinal perfusion, ghrelin secretion was significantly increased by EGCG, but cholecystokinin secretion was not clearly altered.

Conclusions: These results indicate that EGCG enhances ghrelin secretion from ghrelin-producing cells in gastrointestinal tract and increases NYP gene expression in the hypothalamus, suggesting a feeding-promoting effect of EGCG.

Keyword: Epigallocatechin gallate, ghrelin

PAB(T7-254)
Effects of Alaska pollack protein intake on skeletal muscle mass and strength in healthy older women

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Background and Objects: We have reported that the effect of Alaska pollack protein (APP) compared with whey and soybean protein intake on fast-twitch muscle hypertrophy in animal studies. However, the effect of long-term intake of APP on the increase in skeletal muscle mass, muscle strength, and physical function in the elderly has not been clarified so far. The purpose of this study is to evaluate the effects of APP intake on skeletal muscle mass, muscle strength, and physical performance among healthy community-dwelling older Japanese women.

Methods: In this double-blind randomized controlled trial, healthy women > 64 years old aged were allocated into two groups: the an APP intake intervention group and the a whey protein intake placebo (PLA) control group. Participants ingested the test protein meals (4.5 g of protein per serving) daily for 24 weeks. Baseline and intervention between-group differences were evaluated at 4, 12, and 24 weeks, including changes in skeletal muscle mass index (SMI) and muscle strength.

Results: There were no between-group differences in the nutritional status, total energy, total protein, and or food intake at baseline and at 12 and 24 weeks. A significant group-by-time interaction was identified for SMI (12 weeks, Pp=0.029; 24 weeks, Pp=0.013) and knee extension strength (12 weeks, Pp=0.012; 24 weeks, Pp=0.021) at 12 and 24 weeks. At 12 and 24 weeks of the intervention, the rate of change increased in the SMI, and knee extension strength was significantly higher in the APP group than in the PLA group (SMI: 12 weeks, pP=0.030; 24 weeks, pP=0.011; knee extension strength: 12 weeks, pP=0.010; 24 weeks, pP=0.015).

Conclusion: Daily APP intake can increase skeletal muscle mass and lower-extremity muscle strength in healthy older women more than whey protein intake. Therefore, APP intake can be proposed to prevent sarcopenia in older adults.

Keyword: Fish protein, Functional ingredient, Nutrition, Frailty, sarcopenia

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-255)
Hydroxylated soy isoflavones exhibit anti-diabetic properties via the inhibition of alpha-glucosidase and sodium-dependent glucose transporter SGLT1

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Background and objectives: The prevalence of type 2 diabetes (T2DM) is increasing globally. Controlling postprandial hyperglycemia by dietary means is crucial for the prevention of T2DM. Blood glucose levels are determined by various factors including food constituents and food matrix, carbohydrate hydrolyzing enzymes (e.g. alpha-amylase, alpha-glucosidase), glucose transporters and hormones. Although there is some evidence that soy-derived isoflavones such as genistein and glycitein may exhibit antidiabetic properties, little is known to what extent their corresponding hydroxylated metabolites including 8-hydroxy genistein (8OHGen) and 8-hydroxy glycitein (8OHGly) may affect glucose metabolism. Hydroxylation of isoflavones mainly occurs via food fermentation as well as phase I metabolism in the liver.

Materials and Methods: Alpha-amylase and alpha-glucosidase inhibitory activity of a soy isoflavone extract rich in 8OHGen (34% of total isoflavones) and 8OHGly (9 % of total isoflavones) was determined *in vitro* by applying a disc and spectrophotometric assay, respectively. Acarbose was used as a positive control. By mounting Caco2 cells on Ussing chambers we determined the effect of the soy isoflavone extract on sodium-dependent glucose uptake via the glucose transporter SGLT1. Phlorizin was used as a positive control.

Results: *In vitro* alpha-amylase activity was not changed due the soy isoflavone extract. However, we observed a concentration-dependent inhibitory effect of the soy isoflavone extract on alpha-glucosidase activity with statistical significance at a concentration of 10 µg/ml. The IC_{50} value of the isoflavone extract was estimated to be 78.6 µg/ml. Compared to the positive control acarbose (IC_{50} = 493 µg/ml) the soy isoflavone extract was six times more potent in inhibiting alpha-glucosidase. Adding the hydroxy-isoflavone-rich extract at a concentration of 1 µg/ml to Caco2 cells substantially lowered the glucose-induced short circuit current from 9.24 ± 1.73 to 3.63 ± 0.70 µA/cm^2 in the Ussing chamber experiments. This represents a SGLT1 inhibition of approximately 60%.

Conclusion: Our data indicate that a soy isoflavone extract rich in 8OHGen and 8OHGly exhibits potent antidiabetic properties by inhibiting alpha-glucosidase and SGLT1 *in vitro*. Present *in vitro* data should be verified in *appropriate in vivo* studies including laboratory rodents and humans.

Keyword: soy, isoflavones, hydroxylation, bioactivity, glucose metabolism

Conflict of Interest Disclosure: This study was partly funded by Cyclochem Bio Co., Ltd.. Keiji Terao is the president of CycloChem Bio Co., Ltd. Keita Chikamoto, Takahiro Furune, Daisuke Nakata, Yukiko Uekaji and Yoshiyuki Ishida are employees of Cyclochem Bio Co., Ltd. Naoto Hiramatsu is an employee of Toyo Hakko Co., Ltd.

PAB(T7-256)
Inhibitory effects of amber extract on mast cell-mediated allergic reactions

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Background and objectives: Amber is a fossilized tree resin and has been traced in traditional medicines used in Russia and China. In the recent studies, amber extract has been shown the potential to treat and prevent Alzheimer's disease, inflammation-related diseases, and obesity-related diseases. Allergic diseases are inflammatory diseases that have become a global clinical health problem. However, there is still a limited report about amber extract functionality on allergic diseases. Therefore, in this study we aim to evaluate the anti-allergy effects and investigate the mechanism of anti-allergy function of amber extract on RBL-2H3.

Methods: The RBL-2H3 cells were treated with different type of concentration of amber extract. The toxicity of amber extract was conducted using MTT assay test. The RBL-2H3 cell were stimulated with the allergens, PMA/A23187. β-hexosaminidase is used as a marker to measure the efficacy amber extract in preventing mast cell activation and degranulation. ROS generation was also evaluated. The effect of amber extract on cytokines key mediators' production (IL-4, COX-2, p -38, Akt, and JNK) were also investigated.

Results: The result showed that amber extract up to 50 µg/mL has no cytotoxic effect on the RBL-2H3 cells. Treatment with amber extract have significantly suppressed the release of β-hexosaminidase in the dose dependent manner especially at 50 µg/mL concentration. Furthermore, amber extract suppressed the significantly increased amount of intracellular ROS stimulated by PMA/A23187. We also found that amber extract inhibited the increase levels of allergy associated cytokines (IL-4 and COX-2) in a dose dependent manner. In addition, amber extract tends to inhibit the increase of p-38, Akt, and JNK production.

Conclusion: Amber extract was found to suppress the release of β-hexosaminidase and the increased of ROS generation. Amber extract significantly inhibited the increase levels of allergy associated cytokines. Amber extract tends to inhibit the increase of p-38, Akt, and JNK production (MAPK's key mediator). MAPKs phosphorylation are also crucial events in the allergic inflammation response. Taken together, these results suggest that amber extract exerts anti-allergic effects by inhibition of MAPK phosphorylation. These results indicate that amber extract may be a promising new anti-allergic inflammatory agent

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: amber extract, anti-allergy, mast cell

PAB(T7-257)
Protein Content and Amino Acid Profile of *Moringa oleífera* leaf and Its Protein Concentrate

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Background and objectives: Protein is the major macronutrient present in the primary building block of body tissues and an essential nutrient for human body development. Apart from animal sources, plant proteins started gaining attention as a potentially healthier alternative to cover the daily protein recommendation (Richter et al., 2015; Chéreau et al., 2016). *Moringa oleífera*, also known as horseradish tree, is a native plant of India that has been widely introduced to other Asian countries such as Thailand, Malaysia, and the Philippines. The leaves of the plant are reported to have a high nutrient composition of protein, essential amino acids, and other bioactive compounds which can improve human health status (Mishra et al., 2020). Hence, this study focuses on determining the protein content and amino acid profile of raw and cooked *M. oleífera* leaves, and its leaf protein concentrate (LPC).

Methods: Protein content analysis was done using the Kjeldahl method (AOAC, 2000). The crude protein content is expressed as a percentage (%). Amino acids profile was quantified using HPLC with Fluorescence Detector (Azilawati et al., 2015). The amount of essential and non-essential amino acids were expressed as milligram per gram of sample (mg per g). One Way ANOVA with Tukey's posthoc test was used to determine significant differences in protein content between samples.

Results: The protein content of the samples was determined and statistical analysis showed a significant difference between the samples. LPC has the highest protein content (42.4 % ± 0.5869), followed by raw (35.75 % ± 1.378), and cooked leaves (30.38 % ± 0.536). The amino acid profile of the samples was determined. The most abundant essential amino acid detected in raw and cooked leaves was Lycine (84.22 mg in raw sample and 85.05 mg in cooked sample), and Leucine (97.14 mg in LPC). Methionine has the lowest amount detected in the samples. The most abundant non-essential amino acid detected was Glutamic acid while Cysteine was the lowest.

Conclusion: These findings highlight the importance of *M. oleífera* leaves as a source of protein, with particular nutritional significance because they may fulfill the protein and energy requirements of humans.

Keyword: Protein, Amino acid, Moringa oleifera, Nutrition

PAB(T7-258)
Lipid metabolism improving effect of fermented tea made by mixing of unripe Satsuma mandarin (*Citrus unshiu*) an third cropped green tea leaves in rats

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Background and objectives: Satsuma mandarin is most consumed citrus fruit in Japan. Unripe and inedible Satsuma mandarin (USM) is unutilized and discarded despite USM is rich in flavanone glucosides such as hesperidin and narirutin exerting the improvement effect of lipid metabolism. On the other hand, green tea is also most popular beverage in Japan. Third cropped green tea leaves (TGT) is poor quality, so linger on the market. To make effective use of these unused resources, we have manufactured and developed novel tea leaves made by mixing and fermenting of USM and TGT. In the previous study, we revealed that the hot water extract of the mandarin tea leaves, mandarin tea beverage (MTB), has anti-obesity effect in mice. In this study, we investigated the effect of quantitative administration of MTB on lipid metabolism in rats.

Methods:To obtain MTB, 2 g of mandarin tea leaves were extracted with 100 mL of hot water for 5 minutes. Male Sprague-Dawley rats (4-5 weeks old) were fed diet ad libitum prepared according to AIN-93G composition containing 15% of fat and 0.5% of cholesterol for 1 month. Meanwhile, 2.5mL/100g body weight of water or MTB were administrated every other day. At the end of feeding period, energy expenditure derived from exhaled gas were measured for 24 hours by a mass spectrometer for biogas analysis. After anatomization, serum lipid, glucose, hormones involved in obesity, and lipase activity were analyzed with commercial kits. Hepatic lipid and glycogen levels and lipid excretion into feces were also measured.

Results: Body weight and white adipose tissue weight tended to decrease by MTB treatment. Administration of MTB significantly lowered hepatic cholesterol and triglyceride concentrations, serum cholesterol levels, and serum lipase activity. Serum bile acid level and liver functional markers (AST and ALT) tended to lower. The consumption of carbohydrates as energy during the feeding (dark period) was promoted by MTB administration.

Conclusions: These results suggested that MTB could prevent hepatic lipid accumulation and exert cholesterol-lowering effect. Suppression of lipolysis and promotion of carbohydrate consumption may contribute to anti-obesity effect of MTB.

Keyword: unripe Satsuma mandarin, third cropped green tea leaves, mixed and fermented tea beverage, lipid metabolism, rats

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-259)
Active compounds of *Petasites japonicus* Maxim. flower bud extract suppress postprandial blood glucose elevation in mice

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Background and objectives: Although extracts from *Petasites japonicus* exhibit a variety of biological activities, information regarding its antihyperglycemic effects is scarce. Thus, we investigated the inhibitory effects of an 80% ethanol extract of *P. japonicus* flower buds on postprandial hyperglycemia and identified its active compounds

Methods: We prepared an 80% ethanol extract from the powder of freeze-dried flower buds harvested in Tokushima, Japan, in spring 2017. We performed *in vivo* analysis using male Institute of Cancer Research mice to determine the suppressive effects of this extract on blood glucose elevations. Furthermore, we examined the suppressive effects of the active compounds present in fractions, obtained using the liquid–liquid extraction technique, which were then isolated using high-performance liquid chromatography, and identified and quantified via liquid chromatography-mass spectrometry. We also examined the effects of the extract against α-glucosidase prepared from rat small intestine acetone powder with maltose or sucrose as a substrate. Additionally, we compared the contents of the active compounds in extracts from flower buds, stems, and leaves.

Results: Compared with the control, oral administration of the flower bud extract (1,000 mg equivalent of powder/kg body weight) significantly suppressed blood glucose elevations before and simultaneously with glucose, maltose, or sucrose loading. The area under the curve for blood glucose levels was also significantly decreased. Moreover, simultaneous administration of the extract with starch significantly decreased glucose levels. The active compounds were identified as 5- *O*-caffeoylquinic acid, fukinolic acid, and 3,5-di-*O*-caffeoylquinic acid, and they inhibited α-glucosidase against maltose and sucrose. The highest concentration of these active compounds was in the flower buds, followed by leaves and stems.

Conclusions: Three compounds in the extract of *P. japonicus* flower buds were identified as potential suppressors of postprandial blood glucose elevation. They could help maintain glycemic control in cases of hyperglycemia and are potential candidates for the treatment or prevention of diabetes. Furthermore, the leaves of *P. japonicus* are a good source of these active compounds, representing a high-yielding unused resource.

Keyword: Hyperglycemia, Diabetes, Fukinolic acid, Caffeoylquinic acid, Glucosidase inhibitor

PAB(T7-260)
Selenoprotein P regulates resistance to iron-dependent cell death by modulating selenium homeostasis in hepatocytes

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Background and objectives: Selenium is an essential micronutrient responsible for antioxidant function, and its disruption of homeostasis is known to be a factor in lifestyle-related diseases such as type 2 diabetes. Selenoprotein P (SeP) is a major selenium-containing protein in human plasma and is mainly synthesized in the liver. It functions as a selenium-transporter to maintain antioxidative selenoenzymes in several tissues and plays a key role in selenium-homeostasis and antioxidative defense. Recent studies suggest that patients in the early stages of nonalcoholic steatohepatitis (NASH) have elevated levels of selenium and SeP in their blood, but its physiological significance is not clear. In this study, we focus on the liver as a major producing organ of SeP and elucidate pathophysiological function of the protein.

Methods: We established SeP-knockout HepG2 cells (SeP KO cells) using CRISPR/Cas9 system. Using these SeP KO cells, we compared the expression of major selenoproteins such as GPx1, 4, TrxR1 and SeP to that of SeP wild-type cells by western blotting and quantitative PCR. In vivo analysis was performed by generating SeP KO mice and analyzed the expression of those selenoproteins in the mice liver. We also examined whether SeP KO cells and mice are resistant to cell death caused by the ferroptosis inducers. Intracellular lipid peroxide and free iron production were observed using fluorescent probes to clarify the mechanism of resistance to ferroptosis in SeP KO cells.

Results: We found that knockout of SeP gene causes induction of GPx in hepatocytes *in vitro* and *in vivo*. Interestingly, ferroptosis-induced toxicity was reduced in SeP knockout HepG2 cells. Lipid peroxidation was decreased in SeP KO cells, as expected from the increase in GPx with antioxidant capacity.However, free iron, which promotes the fenton reaction, was also reduced unexpectedly.

Conclusions: These results indicate that genetic suppression of SeP was protective against peroxidative reactions in hepatocytes. It suggests that oversecretion of SeP might be negatively associated with antioxidative properties of liver via the regulation of selenium and iron homeostasis.

Keyword: Selenium, NASH, Ferroptosis, Iron

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-261)
Identification of antioxidant components in purple cauliflower (*Brassicaceae oleracea var. botrytis)*

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Background and objectives: White cauliflower is a commonly consumed vegetable belonging to the *Brassicaceae* family and has several bioactive components. Colored cauliflowers contain high levels of plant pigments that have potent nutritional and health-promoting properties owing to their antioxidant activity. This study aimed to reveal the antioxidant components in purple cauliflower, a variety that differs from white cauliflower.

Methods: Purple and white cauliflowers harvested in Tokushima Prefecture in March 2022 were freeze-dried and powdered in a miller. Extracts were prepared from the powder in acetone/water/acetic acid mixture. Antioxidant activity of the extracts was determined using 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay. Purple cauliflower extract was fractionated using high-performance liquid chromatography to investigate antioxidant components, and the fractions that inhibited DPPH radical scavenging activity were determined. The isolated components in the active fractions were analyzed using liquid chromatography-tandem mass spectrometry and identified by comparing the ultraviolet-visible and mass spectral data from previous reports.

Results: The antioxidant activities of the purple and white cauliflower extracts were 65.1 ± 4.2 µmol of trolox equivalent/g of dry weight and 49.7 ± 5.0 µmol of trolox equivalent/g of dry weight, respectively. Two active peaks with maximum absorptions at 520 nm were observed in the chromatogram of the purple cauliflower extract. In positive mode mass spectrometry, the signal for one peak was m/z 1005, which produced the daughter ions m/z 961, 757, 535, 491, and 287. The other peak with m/z 859 produceed daughter ions of m/z 535, 491, and 287. These results indicate that anthocyanins, cyanidin 3-(coumaryl-caffeyl)glucoside-5-(malonyl)glucoside and cyanidin 3-sophoroside-5-(malonyl)glucoside, are the two antioxidant components. In addition, glucoiberin, a well-known antioxidant component, was detected.

Conclusions: Purple cauliflower extract had a higher antioxidant activity than white cauliflower extract. This study revealed that cyanidin 3-(coumaryl-caffeyl)glucoside-5-(malonyl)glucoside, one of the typical anthocyanins in purple cauliflower, is associated with the higher antioxidant activity of purple cauliflower extract, along with glucoiberin.

Keyword: Purple cauliflower, Antioxidant activity, Anthocyanin, Glucoiberin, Liquid chromatography-tandem mass spectrometry

PAB(T7-262)
Fabrication and characterization of a novel H/J aggregates astaxanthin/ bovine serum albumin/ chitosan nanoparticles

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Background and objectives:Astaxanthin is a hydrophobic carotenoid with various beneficial biological activities. Its use as a bioactive food and pharmaceuticals, however, is limited by its low-water solubility and chemical instability. Due to the terpene unsaturated structure, astaxanthin can self-assembly form H aggregates and J aggregates with different bioactive in certain conditions. Here, our research provided a new method for fabricating aggregates astaxanthin-loaded nanoparticles based on bovine serum albumin and chitosan nanocarriers for improvement of bioavailability

Method: The optimum preparation conditions of aggregates astaxanthin/ bovine serum albumin/chitosan nanoparticles (ABC-NPs) were studied. The properties and formation mechanism of ABC-NPs were characterized by dynamic light scattering (DLS), transmission electron microscopy (TEM), UV-vis spectra, Fourier transform infrared spectroscopy (FTIR) analysis, fluorescence spectra, and circular dichroism (CD).

Results: The resultant ABC-NPs with H-type aggregates astaxanthin (H-ABC-NPs) and J-type aggregates astaxanthin (J-ABC-NPs) were precise fabricated by molecular self-assembly and rotary evaporation, which effectively increase the water dispersibility and stability of astaxanthin. The H-ABC-NPs and J-ABC-NPs were both spheres with particle size around 320 nm 380 nm and positive surface zeta potentials around 25mV 32 mV, respectively. The UV-vis absorption band peaks λ_{max} at 388 nm and 565 nm exhibited the existence of two different H-aggregates and J-aggregates in ABC-NPs, respectively. H-aggregates were the face-to-face structure where the conjugated chains were closely packed and parallel oriented to each other, and J-aggregates were the head-to-tail structure where the aggregates were loosely packed and the coupled aggregates were weak. Moreover, the proposed formation mechanism of ABC-NPs was illustrated mainly by non-covalent interactions.

Conclusions: H-type aggregates and J-type aggregates astaxanthin were novelty capsulation in chitosan and bovine serum albumin (BSA) nanocarriers by molecular self-assembly. Both H-ABC-NPs and J-ABC-NPs were subspherical structure with the average hydrodynamic size less than 400 nm with positive charge. In addition, the encapsulated H or J aggregates astaxanthin exhibited relatively high encapsulation efficiency (both above 90%). Further work is underway to access the bioavailability of H-ABC-NPs and J-ABC-NPs *in vitro* and *in vivo*,which would be favor to the application of novel bioactives delivery systems in the field of nutrient and medicine.

Keyword: astaxanthin, aggregates, self-assembly, nanoparticles, delivery

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-263)
Actual conditions and issue identification regarding health foods for women who wish to become pregnant

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Background and objective: The number of infertility treatments has been increasing in recent years and will be partially covered by insurance starting in 2022, and the number of women who wish to become pregnant is expected to increase further in the future. Because the success rate of fertility treatment is not high, women who wish to become pregnant use all means other than infertility treatment. In particular, they often choose health supplements and other health products. However, there have been few reports on the actual conditions of what kind of health foods are being consumed by the women who wish to become pregnant, including those undergoing infertility treatment. Therefore, the purpose of this study was to clarify the actual situation and issues regarding health foods for pregnant women.

Methods: A web-based research company conducted a survey of pregnant women's attitudes and behaviors toward health foods. The survey was conducted by screening 20,000 women aged 25-39, married, and childless, of whom 900 were taking steps to conceive, had never been pregnant, and were currently consuming health foods.

Results:The age of the subjects was 33.6 ± 5.0 years, and they consumed two or more health foods as their age increased. The monthly cost per month spent on health foods increased with increasing age, and the cumulative cost for health foods to date also showed an increasing trend with increasing age. The percentage of respondents who knew or had heard of the "Dietary Guidelines for Pregnant and Nursing Mothers Starting Before Pregnancy" provided by the Ministry of Health, Labor and Welfare was 35%. Forty-one percent of the respondents were completely unaware of the classification of health foods. Folic acid was the most common nutrient consumed, while vitamin K was considered important by the younger generation. Forty-four percent of the respondents stated that the purpose of taking health foods was to increase the probability of pregnancy, and the percentage increased with age, while those who stated that it was for the health of the fetus in case of pregnancy were more likely to say it was for the health of the fetus at younger ages.

Conclusions: The study clarified the actual situation and issues related to health foods targeted at women who wish to become pregnant. The information necessary for pregnant women to select safe health foods was clarified, which may lead to the establishment of risk communication measures to ensure safety.

Keyword: health foods, health problems, dietary supplement, infertility treatment, pregnancy

PAB(T7-264)
Effects of soy isoflavones, resistant starch and antibiotics in a letrozole treated polycystic ovary syndrome (PCOS) animal model

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Background and Objectives: Polycystic ovary syndrome (PCOS) is the most common endocrine disorder found in women of their reproductive age. PCOS classical symptoms; menstrual irregularity, hyperandrogenism and polycystic ovaries have shown correlations with gut microbiota. In recent studies, various dietary interventions have been used as novel therapeutic approaches for PCOS. The main objectives of our study were to investigate if soy isoflavones, their metabolites are key effectors in lowering the severity of PCOS symptoms and if leaky gut is an important effector of PCOS pathogenesis.

Methods: 5 weeks old female SD rats were divided into 7 groups (n=8). PCOS-like symptoms were induced in 6 groups through oral gavage of letrozole for 3 weeks with simultaneous diet treatments. Control (C) and PCOS (L) groups received a control diet. LS, LR, LSR groups received diets with 0.05% soy isoflavones, 11% RS and a combination of both. LA and LSA groups were treated with an antibiotic cocktail and received the control and soy isoflavone based diets, respectively.

Results: LSR group contained a high concentration of soy isoflavones and equol and displayed a reduction in the severity of menstrual irregularity and polycystic ovaries. Bacterial genera such as, *Blautia*, *Dorea* and *Clostridium* were positively correlated with menstrual irregularity suggesting their effect in the significant reduction of the severity of menstrual irregularity in the resistant starch treated LR group. Compared to control group, L group contained a significantly high proportion of genes responsible for bacterial invasion into intestinal epithelial cells. The mRNA expression level of occludin was significantly high in the LSR group. Moreover, resistant starch treatment significantly increased butyric acid concentration. Antibiotic cocktail treated LA and LSA groups displayed leaky gut status with a significantly high Lipopolysaccharide Binding Protein (LBP) concentration and showed no considerable effects on reducing PCOS-like symptoms.

Conclusion: Soy isoflavone metabolites and resistant starch, together with gut microbiota modulations, decreased the severity of PCOS-like reproductive features by improving the gut barrier and through the effects of butyric acid. In conclusion, we suggest that dietary interventions and gut microbiota modulations could be effectively used in reducing the severity of PCOS reproductive features.

Keyword: PCOS, Soy Isoflavones, Resistant Starch, Antibiotics, Gut Microbiota

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-265)

Role of urinary sodium excretion by *Saccharina japonica* extract in normotensive and hypertensive rats

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Background and objectives: One of the foods used for Japanese cuisine "Washoku" is brown algae, including *Saccharina japonica* (SJ). The extract of SJ (SJE, so-called "Dashi") is often used for soup stock. We previously demonstrated that the intake of SJ and SJE decreases blood pressure (BP) in 2-kidney, 1-clip hypertensive (2K1C) rats, while their intake does not decrease BP in normotensive rats. It is reported that intake of sodium alginate oligosaccharide and potassium, which are contained in SJE, increased urinary sodium excretion (UNaE). However, to our knowledge, it has not been reported the effect of SJE intake UNaE. In this study, we investigated the effects of SJE intake on UNaE in normotensive and hypertensive rats.

Methods: Male Sprague-Dawley rats (6 weeks) were treated with sham operation (SHAM) or clipping the left renal artery (2K1C). After surgery, rats were received a control diet (C) or a diet containing SJE with a normal-salt (0.7% NaCl) for 6 weeks. The amount of SJE used in the diet was extracted from the same amount of SJ in the 5% (w/w) SJ diet, which was previously observed with antihypertensive effects. Systolic BP (SBP) was measured by a tail-cuff method every week. At the end of the protocol, mean arterial pressure (MAP) was measured in each rat under anesthesia. In the last week, 24 hours of urine was collected through a simple metabolic cage to measure UNaE.

Results: Six weeks after the surgery, SBP was significantly higher in 2K1C-C than in SHAM-C (156±4 vs 131±2 mmHg, $P< 0.001$), and a significant decrease in 2K1C-SJE (143±2 mmHg) compared with 2K1C-C ($P< 0.05$). There was no significant difference between SHAM-C and -SJE (131±2 mmHg). The data of MAP were similar to SBP. UNaE was significantly higher in 2K1C-C than in SHAM-C (52.3±1.4 vs 44.2±2.4 mg/day, $P< 0.05$). SJE induced an increase in UNaE in both SHAM (64.2±3.4 mg/day, $P< 0.05$) and 2K1C (60.3±2.9 mg/day, $P< 0.05$). SJE intake increases Na^+ excretion into the urine in SHAM and 2K1C rats, and it may participate in lowering BP in a hypertensive state.

Conclusion: UNaE by SJE intake may contribute to alleviating BP-rise in hypertensive rats.

Keyword: seaweed, prevention of hypertension, renovascular hypertension, sodium excretion

PAB(T7-266)

Comparison of bioactive compounds of sea grape extract (*Caulerpa racemosa*) on soxhletation extraction method and maceration-evaporation method

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Background and objectives: Sea grapes (*Caulerpa racemosa*) are easily found in various regions in Indonesia, including in the waters of Sumatra, Java, and North Sulawesi. This algae has properties as cytosine, antidiabetic, anti-inflammatory, and has a high antioxidant content of phenol groups. This study aimed to analyze the differences in the content of bioactive compounds in sea grape extract in the soxhletation extraction method and the maceration-evaporation method.

Methods: The making of sea grape extract (*Caulerpa racemosa*) begins with the process of cleaning and drying the sample, then it is ground into powder. Sea grape powder was extracted by soxhletation and maceration using 96% ethanol as solvent. The soxhletation process was carried out at a temperature of 70-80°C until it reached 3 cycles, while the maceration process was carried out for 3 x 24 hours and concentrated using a rotary evaporator.

Results: The result obtained in each extraction method was further determined for vitamin C content and total phenol content by UV-Vis spectrophotometer, and antioxidant activity was tested using the DPPH (1,1-diphenyl-2-picrylhydrazil) method. The results showed that the average vitamin C content of sea grape extract in the soxhletation method was 130 mg/100 g and the maceration-evaporation method was 830 mg/100 g. The average yield of total phenol content of sea grape extract with soxhletation and maceration-evaporation methods, respectively, was 96.95 mg GAE/g extract and 116.95 mg GAE/g extract. Meanwhile, sea grape extract with the soxhletation method had an antioxidant activity with an IC_{50} value of 55,489 g/ml, while sea grape extract using the maceration-evaporation method was 249,637 g/ml. Sea grape extract using the soxhletation method contains lower bioactive compounds than the maceration method because it passesthrough heating at high temperatures which make the compounds were easily damaged.

Conclusion: Based on this study, it can be concluded that the sea grape extract using the maceration method has a higher content of bioactive compounds than the sea grape extract using the soxhletation method. Thus, the extraction of sea grapes by the maceration method can be used to produce optimal content of bioactive compounds.

Keyword: Sea grapes, extraction methods, vitamin C, total phenolic, antioxidants

Conflict of Interest Disclosure: None

PAB(T7-267)
Protective effect of tea polyphenol and catechins on acrylamide induced cardiometabolic risk

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Background and objectives: Polyphenolic antioxidants have been suggested to mitigate acrylamide formation during the thermal processing of food. However, their role in protecting the toxicity of exposure to acrylamide and the mechanism of action regarding profile alteration of biomarkers and metabolome remains unclear. The objective of this study was to evaluate the protective effect of tea polyphenol (TP) and catechins as its major antioxidant ingredients on the toxicity of acrylamide via the changes in biomarkers from metabolic profile analysis based on human and animal studies.

Methods: A total of 65 adults were randomized into four groups. Seventeen participants were served a personalized bag of potato chips with a placebo capsule, and the rest were required to consume the identical potato with the varied dose of TP capsule. Moreover, nontargeted urinary metabolomics analysis in acrylamide induced rats administered with and without catechins was conducted using ultra-high performance liquid chromatography linked with a quadrupole-orbitrap high-resolution mass spectrometry.

Results: Our present results showed that supplementation of TP and catechins promoted the excretion of N-acetyl-S-(2-carbamoyl-2-hydroxyethyl)- L-cysteine (GAMA) in urine. We also observed that epigallocatechin gallate (EGCG)/epicatechin (EC) intervention effectively decreased the conversion of acrylamide to glycidamide in rat blood. Metabolomics analysis showed acrylamide-induced metabolic disorders were improved via EGCG/EC supplement including glycolipid metabolism (Alanine, aspartate and glutamate metabolism and D-Glutamine and D-glutamate metabolism) and energy metabolism (tricarboxylic acid cycle). Besides, the EGCG supplement showed an evident effect on the cardiometabolic risk of exposure to acrylamide by regulating the critical metabolites, including phenylalanine and hippuric acid in phenylalanine metabolism.

Conclusions: Our finding revealed that TP and catechins supplement attenuated the toxicity of exposure to acrylamide by promoting the mercapturic acid detoxification pathway and thus increased urinary GAMA levels, which further led to lower HbGA levels in vivo. Moreover, we uncovered that EGCG/EC could improve the acrylamide-induced metabolic disorders in glutamate metabolism and tricarboxylic acid cycle by nontargeted urinary metabolomics analyses. Our findings shed light on the natural antioxidants that could be a therapeutic ingredient for preventing acrylamide-induced toxicity.

Keyword: Tea polyphenol, Epigallocatechin gallate, Epicatechin, Acrylamide, Metabolomics

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T7-268)
Intestinal absorption of heptapeptide QDGYMPW with anti-muscle atrophy effect in cells and rats

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Background and Objectives: Ubiquitination of growth factor receptors in muscle may cause muscle atrophy in bedridden and microgravity environments. As Cblin-like peptide (DGYMP) and QDGYMPW have an ability to inhibit the ubiquitination, the intake of these oligopeptides would be effective for prevention of muscle atrophy, while their bioaccessibility remains unclear. In this study, we thus tried to clarify the transportability of both peptides across Caco-2 cell monolayers and absorbability in Sprague-Dawley (SD) rats.

Methods: Synthetic DGYMP and QDGYMPW were used for 60 min-Caco-2 cell transport experiments at the concentration of 1 mM and for oral administration experiments to 8-week-old SD rats at a dose of 100 mg/kg. Basolateral solution collected at a time-schedule of 15, 30, 45, and 60 min and plasma samples from the tail vein, collected at 0, 15, 30, 45, and 60 min after the administration, were subjected to a LC-TOF/MS in positive ESI mode.

Results and Discussion: In Caco-2 cell transport experiments, DGYMP and QDGYMPW were detected from the basolateral side, with apparent permeability coefficients of and $3.2 \pm 0.4 \times 10^{-7}$ cm/s and $2.5 \pm 0.1 \times 10^{-7}$ cm/s, respectively. In oral administration experiments of both oligopeptides to SD rats, the heptapeptide QDGYMPW was successful detected in intact form at 15 min after the administration in rat circulatory bloodstream, and reached to a significant plasma level of 1.33 ± 0.32 pmol/mL-plasma at 60 min. Both *in vitro* and *in vivo* experiments revealed that the penta- and heptapeptides are an absorbable oligopeptide form.

Conclusion: This study provides the finding that anti-muscle atrophic oligopeptides can be intactly absorbed in the body.

Keyword: absorption, oligopeptide, muscle, atrophy, Caco-2 cell

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-269)

Blueberry and Raspberry powders mitigate Caco-2 cell monolayer permeabilization induced by TNF-α through the modulation of the inflammatory and oxidative stress process

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Background and objectives: The impairment of the intestinal permeability (IP) leads to a low-grade and systemic inflammation which represents a risk for chronic diseases development. It has been postulated that polyphenol-rich foods such as berries, may play a beneficial effect against an increased IP. The aim of the present study was to evaluate the effect of blueberry (BB) and raspberry (RB) on Caco-2 cell monolayer permeabilization, inflammation and oxidative stress.~

Methods: Caco-2 cell monolayer permeabilization was evaluated by using Transwell model, measuring transepithelial electrical resistance (TEER) and paracellular transport of FITC (Fluorescein-5-isothiocyanate)-dextran in the absence/presence of TNF-α pro-inflammatory stimulus (10 ng/ml) and with or without the supplementation of BB and RB powders tested at different concentrations (1 and 5 mg/ml) for 24 hours. The total polyphenols (TPs) content ranged from 12 to 60 µg/ml for RB and from 55 to 275 µg/ml for BB, while total anthocyanins (ACNs) content ranged from 3 to 15 µg/ml for RB and from 11 to 55 µg/ml for BB. The expression of tight junction (TJ) proteins, inflammatory (IL-6 and TNF-α) and oxidative stress (8-hydroxy 2 deoxyguanosine) markers were measured in the supernatants or cell lysate in accordance to the instructions reported in the ELISA kits.

Results: The results have documented that the incubation with BB and RB powders mitigated the loss of Caco-2 cell barrier integrity induced by TNF-α, reported as increased values in TEER and reduced values in FITC. However, this activity was dose and product dependent. In addition, a positive modulation of protein involved in IP such as claudin-1 and occludin was documented. Finally, BB and RB powders were able to counteract inflammation and oxidative stress.

Conclusions: Our findings suggest the potential role of BB and RB to counteract *in vitro* an impairment of IP induced by TNF-α as pro-inflammatory stimulus. This beneficial effect seems to be potentially carried out through a modulation of the expression of TJ proteins, and a reduction of the oxidative stress and inflammation.

Keyword: Berries, Polyphenols, Intestinal permeability, Inflammation, oxidative stress

PAB(T7-270)

Antifibrotic and tumor microenvironment modulating effect of date palm fruit (*Phoenix dactylifera L*) extracts in pancreatic cancer

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Background and objectives:Date palm tree (*Phoenix dactylifera L.*) is one of the oldest crops in Southwest Asia and North Africa. In addition to, dates can be grown in Australia, southern Africa, South America, Mexico, and the United States. Date palm tree belongs to Arecaceae family (Angiosperms, monocotyledon) consisting of about 200 genera and more than 2,500 species. The aim of this study is to prepare and fractionate natural product extracts of the edible part of date fruit. The extracts and its fractions were investigated for antifibrotic and antiproliferative activities in tumor necrosis factor (TNF) stimulated PSCs.

Methods: Maceration method was employed to prepare four different extract of the date fruit utilizing a single solvent system including water, ethanol, acetone, and ethyl acetate. Column chromatography technique was used to fractionate the ethyl acetate crude extract using methanol/dichloromethane solvent system. PSCs were imaged using a Leica DM IRBE microscope. FN1 and α-SMA were determined using immunoblotting analysis. The antiproliferative activity of the date fruit extracts was determined based on the Resazurin assay, and DCFH-DA was used to measure the reactive oxygen species (ROS).

Results: Date fruit fractions reduced fibrosis, decreased PSC activity and reversed the PSCs' fibrotic phenotype. The results indicate the presence of a compound or mixture of compounds, which promote the reversal of PSCs to their quiescent state, detectable by suppression of the secretion of α-SMA.

Conclusion: The findings suggest a new approach for targeting pancreatic cancer through the modulation of PSC activity, thereby possibly enhancing the effect of known anticancer drugs. Moreover, date palm fruit appears to have chemopreventive activity protecting from pancreatic and probably other types of cancer.

Keyword: antifibrosis, antiproliferative, date palm fruit, Phoenix dactylifera L., tumor microenvironment

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-271)
The impacts of piperine on body composition and skeletal system

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Background and objectives: Several components in spice inhibit cytochrome P450 (CYP) isozyme activity. CYP3A4, a xenobiotic enzyme, is mainly expressed in the liver and intestine. A CYP3A4 mutation (gain-of-function) was recently reported to cause vitamin D-dependent rickets. Vitamin D is an important nutrient for bone and muscle function. Therefore, we hypothesized that certain spices could potentially contribute to maintain skeletal mass or function through vitamin D metabolism in the liver or intestine.

Methods: We compared the effect of curcumin or piperine, capsicin on CYP3A4 activity using a Luciferin-IPA assay. We also tested those vitamin D receptor-mediated transcriptional activity using a mammalian-2 hybrid assay. To clarify its physiologic activity, mice (C57BL/6J) were orally administrated piperine (20 mg/kg body weight) 3 times per week from 4 weeks to 10 weeks of age. Muscle mass was measured after mice performed the wire-hang test. Body composition was evaluated by micro-computed tomography. The calcium and phosphate concentration was measured using a Calcium-E Test or Phospha-C Test kit, respectively.

Results: Piperine administration significantly inhibited CYP3A4 activity in HEK293 or HCT116. Piperine also recovered the vitamin D receptor-mediated transcriptional activity inhibited by CYP3A4 overexpression. Mice administered piperine exhibited no change in body weight or food intake, but had a significantly lower subcutaneous fat mass. Piperine did not affect muscle mass, but the wire-hang time (indicating muscle strength) was significantly longer than that of control mice. In mice administered piperine, phosphate excretion was significantly increased and calcium excretion tended to increase. No change was detected in the plasma calcium and phosphate levels, or bone mineral density.

Conclusions: Piperine might inhibit vitamin D catabolism in the intestine (local action), thereby affecting calcium and phosphate absorption. Moreover, piperine is important for muscular strength without inducing muscle hypertrophy. Therefore, it may be beneficial toward preventing frailty and maintaining skeletal function. Further studies are needed to clarify the detailed molecular mechanisms of its actions. The effects of piperine in osteoporosis or muscle atrophy models will be evaluated in subsequent studies.

Keyword: Cytochrome P450, Piperine, Muscle, Bone, Vitamin D

Conflict of Interest Disclosure: This study was supported by Urakami Foundation for Food and Food Culture Promotion.

PAB(T7-272)
Effect of ingestion of powdered sword bean (*Canavalia gladiate*) on blood glucose levels in healthy young women.

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Background and objectives: Recently, it has been suggested that sword bean (*Canavalia gladiate*) has an anti-inflammatory effect and is expected as a functional food. In this study, to investigate the effect on healthy subjects who ingested the sword bean-powdered tea (hereinafter: sword bean) for 1 week, we compared the data from the time point before sword bean intake (described below as Before ingestion) with those from 1 week after ingestion of sword bean (After ingestion).

Methods: Healthy female volunteers (20-24 years, average body weight 57.9 kg) were separated into three groups (n = 3-5). Each group ingested 0.6, 1.2, 6.0 g of sword bean per day (0.2, 0.4, 2.0 g/meal), respectively. Sword bean was ingested before each meal (three meal per day) for a week. We analyzed biochemical examinations such as salivary IgA measurements and oral glucose tolerance test and assessed stress levels and body composition at Before- and After ingestions, respectively.

Results: There were no significant differences in body composition and biochemical tests between Before- and After ingestions. Stress indicators of After ingestion tended to be lower than those of Before ingestion in all groups. Postprandial blood glucose levels and the $AUC_{0\text{-}120}$ in After ingestion indicated a reducing trend compared to those in Before ingestion in all groups, showing the significant differences at 60 min after eating in the ingestion of 1.2 g per day and for fasting in the ingestion of 6.0 g per day ($p< 0.05$).

Conclusions: The results of present study indicated that intake of sword bean might suppress the levels of fasting and postprandial blood glucose, suggesting that the ingredients of sword bean enhance the ability to control blood glucose levels.

Keyword: sword beans, postprandial blood glucose level

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-273)
Estimation of the lipase inhibitory effects of the different herbal tea extracts

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Background and objective: Obesity has become a worldwide health problem and is the main risk factor for developing all types of metabolic disorders. Excess accumulation of body fat in obesity could be caused by many factors like sedentary lifestyle, consumption of high-fat diet, genetic predisposition and imbalanced energy metabolism. It is reported that suppressing lipase activity reduces hydrolysis of triglycerides into monoglyceride and fatty acids that helps for reducing fat absorption through the small intestine. Herbal teas contain various potentially bioactive phytochemicals and, in this study, their effects against obesity were investigated by estimating the polyphenol content and pancreatic lipase inhibitory effects.

Methods: Persimmon leaf tea and Manchurian wild rice (Makomo) leaf tea and others, which are made in Shimane prefecture, were prepared by hot water extraction. Polyphenol content was estimated by Folin-Ciocalteu methods with gallic acid as standard. To estimate the lipase inhibitory effects, porcine pancreatic lipase was reacted with triolein as standard substrate with or without tea extract and the liberated fatty acid were determined with GC-MS.

Results: It was observed that in these tea extracts polyphenol content were dependent on the amount of tea leaves and the heating time for extraction. When these herbal teas with similar polyphenol contents were compared, persimmon leaf tea showed the strongest inhibitory effect than other teas. The activity of persimmon leaf tea was dependent on its polyphenol content, whereas the effect of Makomo leaf tea was not correlated with its polyphenol content. There were also other teas found that showed potential for inhibiting pancreatic lipase.

Conclusion: Persimmon leaf tea showed to be highly active for reducing dietary fat digestion, indicating to be potentially beneficial for anti-obesity. Further study is necessary to reveal what compound is responsible for such effects. Makomo leaf tea and others will be also investigated further to estimate their potentials

Keyword: Herbal Tea, Pancreatic lipase inhibition, Dietary fat, Polyphenol, GC-MS

Conflict of Interest Disclosure: None

Further Collaborators: No

PAB(T7-274)
Characterization and Isolation of Lactic Acid Bacteria Probiotic Candidates from Fermented Meats

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Background and objectives: With increasing public awareness for healthier lifestyle, there is growing market demand for functional foods/supplements which contain probiotics. Probiotics lactic acid bacteria (LAB) are defined as live microorganisms which confer health benefits to the host when administered in adequate amounts. The purpose of this study was to screen for novel probiotic candidate(s), as probiotic features and health benefits conferred, which are known to be strain-specific.

Methods:The biodiversity of 106 LAB isolates sourced from fermented meats was investigated using 16S rRNA and GTG_5 PCR fingerprinting. Antagonistic activity and production of organic acids were investigated against 22 distinct strains. Antibiotic susceptibility, hydrophobicity, auto-aggregation capacity, ability to withstand simulated gastric juice (0.3% pepsin), bile salt (0.3%), phenol (0.2 & 0.5%) and NaCl (1.5 to 3.5%) were assessed to select for probiotic candidates. Presence of bacteriocin-associated gene clusters and probiotic gene markers were analyzed. Two-way ANOVA verified with Tukey's multiple comparison tests was performed; a p-value of < 0.05 was considered statistically significant.

Results: *Lactiplantibacillus plantarum* was the most dominant species in the fermented meats. *L. plantarum* strains were found as the strongest lactate producer (106 mM to 158 mM). *L. plantarum* strains effectively inhibited all bacteria and fungal indicator strains tested. *L. coryniformis* subsp. *torquens* and *L. plantarum* displayed significantly greater hydrophobicity (31.2 to 42.2%) compared to *L. plantarum*, *L. sakei* and *P. acidilactici* (4.9 to 18.1%). *L. plantarum* strains showed highest auto-aggregation levels (63.6 to 69.0% at t = 24 h), highest tolerance to 0.3% bile salts, simulated gastric juice, phenol, and salt compared to strains of other species. Overall, *L. plantarum* 41G was identified as the most robust probiotic candidate possessing probiotic gene markers (*bsh*, *fbp*, *mub*) and also a bacteriocin producer.

Conclusions: Novel proposed probiotic candidate *L. plantarum* 41G was successfully isolated, characterized and potentially could be further developed into functional foods. This strain was the most susceptible to antibiotics (compared to other isolates belonging to the same species), with moderate hydrophobicity and auto-aggregation value, high tolerance to bile salt, phenol and NaCl stress, while it was also able to survive simulated gastric juice conditions for 2 to 3 h incubation.

Keyword: diversity, antimicrobial, organic acid, bacteriocin

Conflict of Interest Disclosure: None

PAB(T7-275)

Mori Cortex radicis extract protected against diet-induced neuronal damage by suppressing the AGE-RAGE/MAPK signaling pathway in C. elegans and mouse model

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Background and objectives: Metabolic syndrome (MetS) is a cluster of obesity, hypertension, high cholesterol levels, and hyperglycemia. Many studies have concluded a diet rich in sugary drinks and saturated fat elevates the risks of obesity, metabolic disorders, cardiovascular disease, and cognitive abnormalities. *Mori cortex radicis* (MCR), the root bark of *Morus alba* L., is a well-known herbal medicine in Asian countries and has been used for more than 1000 years to treat diabetes

Methods: In the present study, we investigated the effect of MCR on the underlying mechanisms of MetS and the risk of AD factors using *C. elegans* and a mouse model.

Results: In glucose-induced *C. elegans*, MCR attenuated metabolic disorder by inhibiting lipid and advanced glycation end products (AGEs) production, reducing oxidative stress, and preventing cognition and behavioral deficits. In high fat/liquid sugar-induced MetS mice, MCR intervention improved metabolic alterations and spatial memory. Furthermore, MCR in diet suppressed AGEs deposit and RAGE expression, improved the antioxidant system, and decreased pro-inflammatory cytokine levels in mouse hippocampus. This was accompanied by downregulation of the MAPK (p38, ERK, and JNK) pathway, which consequently protected against brain damage by suppressing BACE-1, APP, Tau, and βA.

Conclusion: These findings may be valuable for those investigating crosstalk between MetS and neurodegenerative disease progression or the effect of MCR on the AGE-RAGE/MAPK pathway.

Keyword: metabolic syndrome, advanced glycation end products, Mori cortex radicis, MAPK pathway, neurodegenerative disease

Conflict of Interest Disclosure: None

PAB(T7-276)

L-Serine depletion induces membrane lipid remodeling accompanied by activation of interleukin-6 signaling pathway in Phgdh-deficient MEFs

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Background and objectives: 3-Phosphoglycerate dehydrogenase (Phgdh) is the first committed enzyme in the *de novo* L-serine (L-Ser) biosynthetic pathway. Mice with systemic inactivation of *Phgdh*gene show severe intrauterine growth retardation, leading to embryonic lethality (Yoshida et al, 2004). In immortalized mouse fibroblasts (KO-MEFs) established from the above KO mouse embryos, we observed that L-Ser depletion led to impaired sphingolipid metabolism and cell death (Esaki et al, 2015; Sayano et al, 2016). Simultaneously, gene expression analysis revealed that a marked induction of genes involved in cholesterol and phospholipid metabolism occurred at the early stage of L-Ser deficiency in KO-MEFs (Hamano et al, 2016). In the present study, we aimed to clarify a possible mechanistic link between altered lipid metabolism and cell injury in L-Ser depleted KO-MEFs.

Methods: KO-MEFs and KO-MEFs^{+Phgdh} were cultured in L-Ser-supplemented or -depleted medium for 6 or 24 hours. Then, we conducted comparative lipidomic analysis by LC-TOFMS and DNA microarray analysis. Gene expression data were analyzed further by Ingenuity Pathway Analysis, and expression levels of identified differentially expressed genes were verified by QRT-PCR.

Results: Lipidomic analysis revealed that L-Ser depletion led to increases in cholesterol together with lysophospholipids and fatty acids. Microarray analysis showed a marked upregulation of gene expression involved in lipid metabolism and inflammatory response including proinflammatory cytokine interleukin-6 (IL-6). Since such lysophospholipids include proinflammatory lipid mediators activating the IL-6 signaling, we examined whether IL-6-Jak/Stat cascade was altered in L-Ser-depleted KO-MEFs. The gene expression analysis confirmed transcriptional activations of IL-6 and its downstream target genes upon L-Ser deficiency.

Conclusions: These observations indicate that cellular L-Ser deficiency promotes lipid remodeling via the degradation of membrane phospholipids, which may cause cell injury via the production of proinflammatory lipid mediators and the activation of proinflammatory IL-6 signaling.

Keyword: L-serine deficiency, cholesterol, lipid metabolism, interleukin-6

PAB(T7-277)
Antioxidant and Prebiotic activity of Pectin from banana peel as a health-promoting ingredient.

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Background and objectives: Pectin is a non-starch polysaccharide widely used in the food industry as a gelling agent, thickening agent, stabilizer and fat substitute, and in pharmaceutical industries as the bioactive components, plus in biomedical application for tissue engineering and drug delivery. It is also a dietary fiber that has biological functions. Pectin can be found in food by-products such as citrus peel, apple pulp and banana peel. Banana is a common food worldwide, but the peel is often discarded. This research aimed to extract pectin from banana by-products and identify its properties which have the potential to be functional foods.

Methods: Pectin was extracted from banana peels (BP), banana stem (BS) and orange peels (OP), sources of commercial pectin, by using solvent and acidic water extraction. All samples were characterized for their chemical properties (the degree of esterification (DE) and anhydrouronic acid (AUA) content), antioxidant activity (using ABTS and FRAP methods), and prebiotic activity.

Results: The BP pectin and BS pectin were categorized as low methoxyl pectin with the DE 37.08 ± 1.72% and 33.91 ± 1.34%, respectively, while OP pectin was high methoxyl pectin (76.50%). The BP, BS and OP pectin had an AUA contents of 46.30 ± 0.43%, 40.05 ± 3.74% and 65.63± 2.54%, respectively. The antioxidant activity of BP pectin was significantly ($p < 0.05$) higher than those of pectin from BS and OP according to both ABTS and FRAP methods. For the prebiotic activity, the survival of *Lactobacillus paracasei* and *Bifidobacterium lactis Bb12* in pomegranate juice with BP pectin added for 14 days were significantly higher (6.20 ± 0.02 and 5.71 ± 0.004 log CFU/ml, respectively), than those without pectin (4.24 ± 0.04 and 4.18 ± 0.14 log CFU/ml, respectively).

Conclusion: Pectin from BP was low methoxyl pectin which could be used as gelling agent, emulsifier and thickener in food industries. It also had high antioxidant activity and prebiotic activity. Therefore, BP could be considered as a potential raw material for the production of value-added pectin which has health-promoting attributes.

Keyword: pectin, dietary fiber, banana, antioxidant, perbiotic

Conflict of Interest Disclosure: None

PAB(T7-278)
Melinjo (*Gnetum gnemon L.*) seed extract improves sleep quality in diet-induced obesity mice

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Background and objectives: We investigated the effect of dietary melinjo (*Gnetum gnemon L*) seed extract (MSE) on sleep architecture in high-fat diet (HFD)-induced obese mice.

Methods: Forty C57BL/6J male mice were fed different diets for 17 weeks: normal diet (ND), ND with 1% MSE (ND+MSE), HFD, and HFD with 1% MSE (HFD+MSE). Body weight and sleep architecture were examined in all mice after the study period.

Results: The body weight of HFD-fed mice increased by 50% compared to that of ND-fed mice. Although HFD did not affect the amount of non-REM (NREM) sleep, the average duration of NREM sleep bout was significantly shortened, and the number of NREM sleep bout was significantly increased. These findings indicate fragmented NREM sleep and altered sleep architecture in HFD-fed mice. Dietary MSE did not affect body weight or sleep architecture in the ND+MSE-fed mice. In contrast, the body weight and sleep architecture of HFD+MSE-fed mice were almost identical to those of ND-fed mice, indicating that dietary MSE completely blocked HFD-induced weight gain and sleep fragmentation.

Conclusions: Our data provide compelling evidence that MSE is a novel and promising dietary supplement that restores obesity-induced impaired sleep architecture.

Keyword: sleep quality, diet-induced obesity, Melinjo (Gnetum gnemon L.)

Conflict of Interest Disclosure: This study was funded by Yamada Bee Company Inc.

PAB(T7-279)
Bioavailability of kawakawa (*Piper excelsum*) tea metabolites in healthy human volunteers

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Background and objective: Interest in functional foods has led to the scientific investigation of the chemistry of *Piper excelsum* or kawakawa due to its therapeutic use by Māori in Aotearoa New Zealand. Certain phytochemicals in kawakawa have been reported to influence nutrient uptake and to have anti-inflammatory activity. We report the first human study to investigate the bioavailability of potential biologically active metabolites in healthy individuals following kawakawa tea consumption.

Methods: A pilot study (BOKA T) was undertaken to investigate the bioavailability of compounds derived from kawakawa leaves and which are present in hot water leaf extracts ('tea'). Healthy participants were randomized to consume either kawakawa tea (1g/250mL or 4g/250mL) or hot water. A follow-up study to assess the impact of kawakawa tea ingestion on postprandial glucose metabolism in healthy human volunteers (TOAST) was conducted in which participants consumed a tea (4g/250mL) or hot water. Non-targeted and targeted high-resolution LC-MS/MS metabolite analyses were undertaken on plasma and urine samples collected at regular intervals from both BOKA T and TOAST. Targeted analyses included six compounds known to occur within kawakawa tea, namely myristicin, elemicin, fagaramide, pellitorin, yangambin and vitexin, and for which authentic standards were available.

Results: Known kawakawa metabolites were not observed in plasma and urine samples in unmetabolized or unconjugated forms. Thirty urinary metabolites were significantly associated with kawakawa tea consumption in a dose-dependent manner, of which eight were also present in plasma, with others detectable in plasma at trace levels. The plasma and urinary metabolites derived from kawakawa are likely to have arisen by biotransformation by the gut microbiota and phase 1 and 2 metabolisms, such as those from myristicin and elemicin.

Conclusion: Kawakawa tea is well tolerated by the participants after an overnight fast. Analysis of urine indicates that several kawakawa metabolites are bioavailable. These metabolites may provide biomarkers for kawakawa consumption as well as provide an indication of which kawakawa metabolites may underlie the reported therapeutic properties of this traditional herbal medicinal plant. Further studies are required to elucidate the pathways for the transformation and metabolism of kawakawa leaf metabolites.

Keyword: Kawakawa, phytochemicals, bioavailability, metabolites , biotransformation

PAB(T7-280)
Comparison of blood and urine concentrations of equol in healthy males and females by LC-MS/MS method and examination of factors affecting equol production

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Backgrounds and objectives: Equol is an active metabolite of daidzein, one of the soybean-derived isoflavones. It is produced by the action of intestinal bacteria and has an estrogenic effect. Equol producers were associated with mild menopausal disorder, good bone density and lipid profile, low risk of breast cancer and prostate cancer. However, different individuals have different metabolism of isoflavones, especially equol. In this study, we aimed to investigate the relationship between blood and urine equol concentrations and their relationships with other parameters, such as sex, age, endocrine function, glucose metabolism, lipid metabolism, and renal function.

Methods: We simultaneously measured the equol concentrations from the blood and urine of 466 healthy men and women (292 men and 174 women) aged between 22 and 88 (mean age 55) years who had given informed consent. Equol concentrations were determined by LC-MS/MS method. Equol producers were defined as those whose log ratio of urinary equol and daidzein concentration or log (equol/daidzein) was -1.42 or higher.

Results: Among 466 cases, 195 were equol producers (42%). The proportion of equol producers in females was larger than that in males (39% versus 47%). There was no significant difference in the urine/blood ratio of equol concentration between producers and non-producers in both males and females. PSA levels in men were significantly lower in equol producers (0.8 v.s. 1.0 ng/ml, p=0.004), especially in those in their 40 s (0.82 vs. 1.13 ng/ml, $p < 0.001$) and 60 s (0.64 vs. 1.02 ng/ml, $p < 0.001$). The proportions of equol producers were lower among those with high PSA levels (4.4% vs. 5.1%, p=0.068). In addition, a significant proportion of men with high LDL cholesterol levels were equol non-producers (48.9% vs. 36.8%, p=0.043), and equol non-producers tended to have lower HDL cholesterol and higher uric acid levels.

Conclusions: The equol-producing ability tended to be higher in females, suggesting a relationship between estrogen and equol-producing ability. There was no difference in urinary excretion due to equol-producing ability in both males and females. Male equol-producers had significantly lower PSA levels, suggesting reduced risk of prostate disease. They also have low blood lipids and uric acid levels.

Keyword: Equol, Equol producers, PSA

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-281)
Effects of Alaska pollack protein intake on skeletal muscle mass and strength in older people requiring for nursing care

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Objective: In Japan, the population of individuals above 75 years of age, i.e., the super-aged population, is increasing. This will increase the requirement for nursing care for older people due to frequent sarcopenia-related complications caused by malnutrition and inactivity. Alaska pollack fast muscle protein (APP) consumption increases gastrocnemius muscle weight and fast muscle fiber in rats. In clinical trials, APP intake for approximately three months increased skeletal muscle and strength in healthy older people and women in their twenties. However, the effects of APP on the skeletal muscle of older people requiring nursing care are unclear. We investigated the effects of APP intake on skeletal muscle mass, muscle strength, and physical function in older people requiring nursing care in a single group before and after 12 weeks of APP intake.

Methods: Twenty-one elderly volunteers requiring nursing care (level 1–3) participated in the study. The test meal (5 g protein per serving; APP: 4.5 g) was provided once a day for 12 weeks. The skeletal muscle mass index (SMI) of the extremities, secondary outcomes of body weight, lower leg circumference, grip strength, and maximum walk speed were evaluated before and after (four and 12 weeks) the intervention.

Results: During the study, six volunteers dropped out; thus, only 15 were included for analysis. The median age of the participants was 86 years, and 10 presented with sarcopenia. The median BMI before the intervention was 21.9 kg/m^2. The intake rate of the test meal was 75.9%. No significant changes were observed for each outcome after four weeks. After 12 weeks, SMI, body weight, and grip strength increased significantly ($p < 0.05$), whereas walk speed did not increase.

Conclusion: APP intake (4.5 g once daily) for 12 weeks increased skeletal muscle mass and strength in the older population, requiring long-term care.

Keyword: Alaska pollack protein, skeletal muscle mass, muscle strength, older adults, sarcopenia

PAB(T7-282)
Comparison of effects on lipid metabolism of different fats and oils in high-fructose and high-glucose diets in rats

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Background and objectives: Excessive intake of fructose has been reported to be associated with the development of metabolic syndrome. The physiological effects of fats and oils differ greatly depending on the fatty acids they contain. This study compared the effects of different fats and oils in high-fructose and high-glucose diets in rats.

Methods: We conducted 2 feeding studies. In Experiment 1, rats were divided into 4 groups and fed a high-fructose diet containing fish oil (HFFO) or soybean oil (HFSO) and a high-glucose diet containing fish oil (HGFO) or soybean oil (HGSO) for 4 weeks. In Experiment 2, rats were similarly divided into 4 groups and fed a high-fructose diet containing lard (HFLD) or medium-chain triglycerides (HFMCT) and a high-glucose diet containing lard (HGLD) or medium-chain triglycerides (HGMCT) for 4 weeks. To analyze the significance of sugar type and fats and oils type, a two-way ANOVA was used with Tukey's multiple range test

Results: In Experiment 1, sugar type effect and fats and oils type effect were observed for plasma triglyceride (TG) level, which was increased by fructose and decreased by fish oil. The interaction (sugar type*fats and oils type) was observed for hepatic TG level, which was lowest in the HGFO group and did not differ in the HFSO, HFFO, and HGSO groups. These results indicate that hepatic TG accumulation by excessive intake of fructose occurs differently with soybean oil or fish oil. In Experiment 2, sugar type effect and fats and oils type effect were observed for plasma TG level, which was increased by fructose and lard. Hepatic TG level did not differ among the groups, which was not match the gene expression results that showed up-regulation of fatty acid synthesis by fructose and MCT, and up-regulation of fatty acid oxidation by fructose and lard.

Conclusions: These results revealed a difference in the physiological effects of fats and oils in high-fructose and high-glucose diets.

Keyword: Fructose, Fats and oils, Lipid metabolism, rats

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-283)

IRW improves glucose tolerance via activation of AMPK pathways and endothelial nitric oxide regulated by ACE2 in the aorta of in high fat diet fed C57BL/6 mice

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Background and objectives: IRW, an ovotransferrin-derived tripeptide, has demonstrated antihypertensive and anti-inflammatory activities in cells and rodents. In this study, we investigated the effects of IRW on endothelial function, inflammation, and glucose homeostasis in a high-fat diet (HFD) induced obesity model. Methods: C57BL/6 mice were fed HFD (45% of total calories) for six weeks and IRW was added into the diet (45 mg/kg body weight (BW)) for another eight weeks.

Results: HFD lead to endothelial impairment through the down-regulation of the endothelial 5'-AMP-activated protein kinase (AMPK)–eNOS cascade while up-regulation of MAPK pathway, probably related to high lipid levels and impaired glucose management. IRW improved glucose transporter 4 (GLUT4) abundance in membrane ($P< 0.05$), AMPK ($p< 0.05$), Sirtuin 1 ($p< 0.05$), and eNOS protein expression of IRW-treated mice. Angiotensin-converting enzyme-2 (ACE2) protein levels increased in aorta ($p< 0.05$) while angiotensin one receptor (AT1R) abundance significantly reduced ($P< 0.05$) in the aorta of HFD mice treated by IRW. Further, IRW down-regulated the inflammatory MAPK signaling to reduce inflammation and vasoconstriction.

Conclusions: In conclusion, IRW improves glucose uptake and Insulin resistance in HFD-fed mice, which contribute to causing vasodilation, anti-hypertrophy, and improving vascular function. IRW promotes vasodilation action in the aorta via multiple signaling pathways, including AMPK and eNOS, dependent on ACE 2 expression.

Keyword: IRW, insulin resistance, obesity, eNOS, ACE2

Conflict of Interest Disclosure: None

PAB(T7-284)

Antistress activity of some phytochemicals: screening, identification, validation, and potential applications

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Background and objectives: Environmental stresses have been shown to contribute to poor quality of life, tissue dysfunctions and ailments including metabolic disorders, cognitive impairment, and accelerated aging. Oxidative stress (an imbalance between the production and processing of highly reactive oxygen species) is largely associated with these phenotypes. Whereas drug development and disease therapeutics have advanced remarkably in last three decades, there are still limited options for stress management. Since the later can effectively decrease the disease burden, we aimed to screen phytochemicals with anti-stress activity using cell-based assays

Methods: We recruited chemical models of oxidative (paraquat), metal (cadmium nitrate) or hypoxia (cobalt chloride) stresses. Control and stressed cells were allowed to recover either in the control or phytochemical supplemented culture medium. Cell survival and protein expression/signaling were analyzed to select the useful compounds and/or plant extracts.

Results: Cells subjected to chemical stresses showed a decrease in their viability. Three rounds of blind screening of the 24 phytochemicals resulted in the identification of 5 phytochemicals (four compounds and one Ashwagandha extract possessing these compounds) that caused better recovery of cells. The selected phytochemicals were further examined for their ability to protect cells against metal and hypoxia stresses. We found that whereas stress caused increase in (i) apoptosis (ii) ROS accumulation coupled with mitochondrial depolarization (iii) DNA double-strand break (iiii) protein aggregation, the selected phytochemicals caused remarkable protection. Furthermore, two compounds, withanone (Wi-N) and triethylene glycol (TEG) were also observed to cause differentiation of brain-derived cells and promote the proliferation of senescent human fibroblast. Implication of the results with reference to stress and old age-associated ailments will be discussed

Conclusions: Taken together, the study strongly suggested anti-stress and neuronal differentiation potential of Ashwagandha withanolides and extract that may be recruited for management of stress and old age-related ailments.

Keyword: Cell based assays, phtochemicals, oxidative stress, metal stress, replicative senescence

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-285)
Hormesis-associated mechanisms underlying stress-resistant effects of allyl isothiocyanate

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Background and objectives: Most, if not all, previous studies on phytochemicals have so far evaluated their effects with a single treatment of cultured cells. In general, however, we ingest them multiple times or continuously in daily life. On the other hand, phytochemicals may exhibit hormetic effects since they are substantially xenobiotics to humans. This study aimed to evaluate the stress-resistant effects of multiple treatments with allyl isothiocyanate (AITC), a pungent in wasabi, by focusing on hormesis.

Methods and Results: RGM1 rat gastric mucosa cells were pretreated on four different schedules, in which treatment times and the concentrations of AITC are as follows, group (1) 0 and 24 hr: 0 μM (2) 0 hr: 10-30 μM, 24 hr: 0 μM (3) 0 hr: 0 μM, 24 hr: 10-30 μM (4) 0 and 24 hr: 10-30 μM. Then all four groups were treated with AITC (20 μM), then cell viability was measured. Pretreatment with AITC (10-30 μM) significantly decreased AITC (20 μM)-induced cytotoxicity in group (2)-(4). In group (3), the protective effect was highest at the concentration of 15 μM, then decreased and almost disappeared at 20 and 30 μM, respectively. Group (4) also exhibited a similar trend. In addition, the mRNA expression levels of catalase and HSP27 were higher in the cells exposed to double treatments with AITC (15 and 20 μM, 24 and 6 hr) than those by its single treatment (20 μM, 6 hr). Interestingly, pretreatment with AITC (2.5-15 μM, 1 hr) showed the cytoprotective effects in RGM1 cells, which were incubated in a low pH medium (pH 4.6, 1 hr).

Conclusions: We found that pretreatment with AITC enhances the resistance to cytotoxicity induced by a high concentration of AITC, suggesting that multiple treatments with AITC may increase its adaptation capacity against AITC exposures. Mechanisms underlying stress resistance to AITC, together with that to a low pH condition, are currently under investigation.

Keyword: allyl isothiocyanate, hormesis, stress resistance, cross resistance, RGM1 cells

PAB(T7-286)
Effect of calcium-enriched pumpkin on calcium status and bone health in ovariectomized rats

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Background and objectives: Calcium-enriched pumpkin may be a good potential new source of dietary calcium. This study investigated the effect of an enriched pumpkin with calcium carbonate and calcium lactate on calcium status and bone health in ovariectomized rats.

Methods: The study was conducted on 40 rats and lasted 12 weeks. At the beginning of the experiment, rats were divided into two groups: the control (n = 10) and the study group (n = 30), in which the ovariectomy was performed. The control group (C) and one of the ovariectomized groups (OVX_C) received the standard diet (no modification), the P_CaC group was fed pumpkin enriched with calcium carbonate and group P_CaL was fed pumpkin enriched with calcium lactate. Each diet contained the same amount of calcium (5 g per 1 kg of diet). The pumpkin has been enriched with calcium salts in the process of osmotic dehydration with the use of an osmotically active substance - inulin. At the end of the experiment, the body mass of rats was measured. Blood and tissues were collected, in which the concentration of calcium was determined using flame atomic absorption spectrometry (AAS), while the concentration of procollagen type I N-terminal propeptide (PINP), parathyroid hormone (PTH), estradiol (ES) and osteocalcin (OT) were measured in serum with enzyme-linked immunosorbent assay (ELISA) kits.

Results: Pumpkin enriched with calcium led to the accumulation of calcium in the kidneys of ovariectomized rats. Pumpkin enriched with calcium carbonate increased significantly calcium level in the femur and PTH serum concentration. A comparison of the effect of both salts resulted in significantly higher calcium levels in serum, liver, and kidneys and lower in the femur in rats with calcium lactate-enriched pumpkin.

Conclusions: In conclusion, enrichment of pumpkin with calcium carbonate has a more favorable effect than its enrichment with calcium lactate in increasing the content of calcium in bones with its lower accumulation in the kidneys.

Keyword: pumpkin, calcium salts, ovariectomy, kidneys accumulation

Conflict of Interest Disclosure: None

Further Collaborators: None.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-287)

Docosahexaenoic acid inhibits interaction of RACK1 with PKCθ and represses melanoma and T cell leukemia cell proliferation

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Background and objectives: Docosahexaenoic acid (DHA) is a major marine n-3 polyunsaturated fatty acid. It has been reported that DHA elicits many physiological effects, including anti-tumor effects. However, the mechanisms of its anti-tumor effects are unclear. Previously we found that DHA interacted with receptor for activated C kinase 1 (RACK1), and that repressed melanoma cell proliferation by suppressing protein kinase C (PKC) signaling. These findings suggested that DHA might suppress PKC signaling by inhibiting the interaction of RACK1 with PKC. In this study we examined the effect of DHA on the interaction of RACK1 with PKCs.

Methods: There are nine genes of a human and mouse PKC superfamily. We constructed plasmids that expressed Halo-tagged PKCs and NanoLuc-tagged RACK1. We transfected the Halo-tagged PKCs and NanoLuc-tagged RACK1 in a B16F10 melanoma cell line, and analyzed the interaction of RACK1 with PKCs by bioluminescence resonance energy transfer (BRET).

Results: Phorbol 12-myristate 13-acetate (PMA) is a PKC activator-induced interaction of RACK1 with PKCα, β, γ, θ, ι, or ζ. DHA repressed the interaction of RACK1 with PKCβ and PKCθ. We examined by western blot the expression of PKC isotypes in B16F10 and the effect of DHA on PKC signaling. PKCα, θ, and ζ were expressed in B16F10, but PKCβ was not. DHA decreased the phosphorylation level of JNK protein in B16F10. Next, to examine the relationship of PKCθ expression and DHA's anti-proliferation effect, we analyzed PKC expression and DHA's anti-proliferation effect in B16F10, NIH-3T3, HepG2, DLD-1 and HeLa cell lines. PKCθ expression and DHA's anti-proliferation effect were observed in B16F10 only. PKCθ is well known as an important molecule in T cell activation and proliferation. We examined DHA's anti-proliferation effect on five T cell leukemia cell lines. DHA repressed the proliferation of Jurkat, MOLT-4F, CCRF-CEM, and HPB-ALL, but did not repress the proliferation of HD-Mar2. PKCθ expression was observed in Jurkat, MOLT-4F, CCRF-CEM, and HPB-ALL.

Conclusions: In this study we showed that DHA repressed the interaction of RACK1 with PKCθ, and that the anti-tumor effect of DHA was correlated with PKCθ expression in tumor cell lines. Our results suggest that suppression of PKCθ signaling is a new explanation of the anti-tumor effect of DHA.

Keyword: docosahexaenoic acid, protein kinase C θ, receptor of activated C kinase 1, melanoma, T cell leukemia

PAB(T7-288)

Intestinal absorption of rare sugars, D-allose, D-allulose, D-sorbose, and D-tagatose via sodium-dependent glucose cotransporter 1 (SGLT1) or glucose transporter type 5 (GLUT5) in rats

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Background and objectives: Intestinal absorption pathways of rare sugars (D-allose, D-allulose, D-sorbose, and D-tagatose) are not fully understood. D-allose is an isomer of D-glucose (Glu), while D-allulose, D-sorbose, and D-tagatose are isomers of D-fructose (Fru). We investigated whether these rare sugars are absorbed via sodium-dependent glucose cotransporter 1 (SGLT1) and/or glucose transporter type 5 (GLUT5) in rats.

Methods: Two experiments were conducted to clarify the pathway of rare sugar absorption. In Experiment 1, we tested whether rare sugars are absorbed via SGLT1. Rats previously fed a standard diet were fasted and divided into two groups. One group was orally administered KGA-2727, SGLT1-specific inhibitor, and each rare sugar. The other group was orally administered each rare sugar alone. Blood was collected from the tail vein over time. We also examined this experiment using portal vein cannulated rats. In Experiment 2, we tested whether rare sugars are absorbed via GLUT5. Rats were divided into a Fru group which were previously fed a high-fructose diet to induce GLUT5 in the small intestine and a Glu group which were previously fed a high-glucose diet served as a control. Each rare sugar was orally administered to the fasted rats, and blood was collected from the tail vein over time.

Results: In Experiment 1, KGA-2727 blocked the increase of plasma D-allose concentrations throughout the experiment after D-allose administration. No significant differences were observed between the groups after administration of D-allulose, D-sorbose, and D-tagatose. Similar results were obtained from the experiments using portal vein cannulated rats. In Experiment 2, the Fru group showed significantly higher plasma rare sugar concentrations than those in the Glu group after administration of D-allulose, D-sorbose, and D-tagatose while there were no significant differences when D-allose was administered

Conclusions: The results suggest that D-allose is likely absorbed via SGLT1 but not GLUT5. D-allulose, D-sorbose, and D-tagatose are likely absorbed via GLUT5 but not SGLT1.

Keyword: rare sugars, SGLT1, GLUT5, rats

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-289)
Oral intake of ozonated triacylglycerol from olive oil reduces fatty acid synthesis and inflammation reaction in obese *db/db* mice

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Background and objectives: In recent years, the number of patients with metabolic syndrome has increased due to overeating and lack of exercise, and chronic inflammation caused by excess fatty tissue has resulted in diverse diseases. We previously found that oral intake of ozonated olive oil alleviated liver damage in obese model mice and rats via lipid metabolism improvement. In this study, to investigate the active components in ozonated olive oil, we fractionated olive oil into triacylglycerol (TAG) and unsaponifiable matter (USM) and assessed bioactivity of each ozonated fraction.

Methods: TAG was prepared from the saponifiable fraction of olive oil using a silica gel column. The USM was extracted with diethyl ether from alkali-treated olive oil. Obese model *db/db* mice were fed one of experimental diets containing 6.5% corn oil + 0.5% olive oil (CO group), 6.5% corn oil + 0.5% ozonated TAG (zTG group), or 6.5% corn oil + 0.5% TAG + 0.0058% ozonated USM (zUS group). Normal model C57BL/6J mice fed a standard diet (NO group) were also assessed. After 4 weeks of rearing, growth parameters and lipid metabolism were evaluated.

Results: The CO group developed obesity, hepatomegaly, hyperlipidemia and fatty liver with increased food intake (compared to the NO group). In obese *db/db* mice, the zTG group showed a significant decrease in serum TAG, liver TAG and serum insulin compared with the CO group. As a mechanism of action, the enzyme activity of fatty acid synthase (FAS) and the expression of lipogenic genes (*ACC1*, *FAS* and *SCD1*) and inflammatory genes (*MCP1* and *TNFα*) were significantly decreased in the zTG group than the CO group. The zUS group was not significantly different from the CO group in any of the tests.

Conclusions: The results of this study suggest that ozonated TAG in olive oil shows bioactive functions in reduction of fatty acid synthesis and anti-inflammation.

Keyword: Anti-inflammation, Fatty acid synthesis, Metabolic syndrome, Oil and fat, Ozone

PAB(T7-290)
Yam-Derived Nanovesicles Stimulate Osteoblast Formation and Prevent Osteoporosis in Mice

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Background and objectives: Bone mineral density and function are maintained by the constant differentiation and mineralization of osteoblasts to prevent osteoporosis. The effects of yam-derived nanovesicles (YNVs) on the promotion of differentiation and mineralization of osteoblasts *in vitro* and in ovariectomized (OVX)-induced osteoporotic mice are investigated.

Methods: In this study, the isolated YNVs are verified as nanovesicle-containing biomolecules, including RNAs, proteins, and lipids, following an established method, including nanoparticle tracking, dynamic light scattering analysis, and electron microscopy

Results: These exogenously administered YNVs induce the proliferation, differentiation, and mineralization of osteoblasts by increasing the expression of Runx2, which is a key transcription factor for osteoblast differentiation. The YNVs stimulate osteogenic activation of the BMP-2/p-p38-dependent Runx2 pathway. Furthermore, oral administration of YNVs promotes longitudinal bone growth and mineral density of the tibia in the OVX-induced osteoporotic mice but not in normal mice. Significant increases in osteoblast-related parameters confirm these results.

Conclusions: Taken together, these results demonstrate that YNVs can serve as a safe and effective agent for enhancing osteogenic activity.

Keyword: exosome-like nanovesicles, yam-derived nanovesicles, bone mineral density, osteoporosis

PAB(T7-291)
Polyphenols from *Litsea cubeba* exert anti-inflammatory activity through Nrf2/HO-1 pathways in Caco-2 cells.

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Background and objectives: Inflammation has been known to trigger metabolic disorders such as insulin resistance and immune impairment. Intestine, where various types of immune cell are abundant, is continuously exposed to food-borne

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

pathogens and intestinal bacteria, causing chronic inflammation. Although commercially-available anti-inflammatory drugs have been used, long term usage of them often causes undesirable side effects. Natural compounds from plants accordingly have been investigated as safer alternative to provide anti-inflammation effects. Among them, *Litsea cubeba*, a seasoning in Asian countries, has been used as a traditional folk medicine to treat digestive anomalies. Few studies, however, have been carried out to determine how *L. cubeba* modulates inflammation in digestive system. We here aimed to investigate anti-inflammatory activity *L. cubeba* in Caco-2 cells.

Methods: Caco-2 cells were pretreated with *L. cubeba* 50% aqueous ethanol extract before H_2O_2 treatment. Western blotting and qRT-PCR were used to analyze the effects of *L. cubeba* on inflammation and anti-oxidant-related proteins such as nuclear factor (erythroid-derived 2)-like 2 (Nrf-2) and heme oxygenase 1 (HO-1). Besides, LC-MS/MS was employed to identify bioactive components present in the extract. To determine the possible mechanism of action, *in silico* molecular docking was also used.

Results: *L. cubeba* 50% aqueous ethanol extract was found to have a protective effect against H_2O_2 induced inflammation in Caco-2 cells. The extract dose-dependently downregulated the gene expression levels of IL-6. Moreover, the protein and gene expression levels of Nrf-2 and HO-1 were upregulated, and nuclear translocation of Nrf-2 was also promoted, which in turn may enhance the activity of antioxidant enzymes. Furthermore, LC-MS/MS analysis revealed the presence of several polyphenolics belonging to the flavonoid and alkaloid classes. Additionally, several kaempferol glycosides demonstrated high docking binding scores against Kelch-like ECH-associated protein 1 (Keap1), a regulator of Nrf-2.

Conclusions: These results exhibited anti-inflammatory potential of *L. cubeba* through anti-oxidant pathway of Nrf-2/HO-1, which may be due to the flavonoid presence.

Keyword: Litsea cubeba, inflammation, Nrf-2, HO-1

PAB(T7-292)
Extract derived from *Litsea cubeba* leaves increases glucose uptake in HepG2 cells via enhanced AMPK/GLUT2 pathway

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Background and objectives: With increased number of obese people, natural compounds have drawn attention to develop functional foods to maintain healthy body weight and blood sugar levels. *Litsea cubeba* grown and eaten in Asian countries, has been traditionally used to treat diabetes. Few studies, however, have shown anti-diabetic activity of *Litsea cubeba*. We accordingly aimed to investigate how leaves from *Litsea cubeba* modify glucose metabolism in HepG2 cells.

Methods: *Litsea cubeba* leaves extract was prepared as 50% ethanol aqueous extract. Total polyphenol levels in the extract were measured by Folin-Ciocalteu's method. HepG2 cells were seeded at 9.0 x 10^4 cells/cm^2 on culture plates and were then treated with 25 - 100 μg/mL of *Litsea cubeba* leaves extract. Glucose uptake and cell viability were measured by glucose uptake assay kit and cell counting kit, respectively. Cell surface glucose transporter 2 (GLUT2) expression was analyzed by flow cytometry. The protein expression of phospho-AMP-activated protein kinase (AMPK), total AMPK and sirtuin 1 (SIRT1) was determined by western blot.

Results: Total polyphenol levels in *Litsea cubeba* leaves extract were 180 μg gallic acid equivalent/mg extract. Glucose uptake was dose-dependently increased and was significantly elevated at the concentration of 100 μg/mL of *Litsea cubeba* leaves extract without affecting cell viability. The expression of cell surface GLUT2 was increased in a dose-dependent manner and augmented significantly with 100 μg/mL of the extract. Phospho-AMPK protein expression was significantly stimulated, but no increased expression of total AMPK protein was detected by *Litsea cubeba* leaves extract. SIRT1 protein expression, an upstream regulator for AMPK signaling, was not modified by the extract.

Conclusions: *Litsea cubeba* leaves extract increased glucose uptake in HepG2 cells via enhanced AMPK/GLUT2 pathway. *Litsea cubeba* leaves could be thus useful for normalizing glucose metabolism in the liver.

Keyword: Litsea cubeba leaves, glucose uptake, AMPK, GLUT2, polyphenols

PAB(T7-293)
Collagen tripeptide alleviates allergic rhinitis symptoms in mice

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Background and objectives: Collagen tripeptide (CTP) is a collagen hydrolysate containing high concentrations of tripeptides with glycine-X-Y sequences. Residues X and Y are arbitrary but often occupied by proline, hydroxyproline, and/or alanine. CTP has excellent skin permeability and promotes the synthesis of hyaluronic acid. Further, CTP is reported to exert an anti-inflammatory effect on atopic dermatitis. Based on these reports, we evaluated the effect of CTP on allergic rhinitis, an inflammatory diseasefinal, using a mouse model of ovalbumin-induced rhinitis. In addition, we examined the effect of CTP on the immune system in the mouse spleen.

Methods:To prepare the rhinitis model, BALB/c female mice were sensitized with ovalbumin (OVA). CTP was dissolved in tap water and given *ad libitum* from a water bottle. Control mice received tap water only. CTP administration was continued for 5

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

weeks from the day of first sensitization in the study of preventive efficacy, and for 4 weeks from the time when rhinitis worsened in the study of therapeutic efficacy. Some mice were given normal collagen peptide (CP), which did not contain CTP. Rhinitis symptoms (sneezing and nasal rubbing) were observed once weekly. The plasma levels of OVA-specific IgE antibodies (OVA-IgE) were measured over time. After a final observation of rhinitis symptoms, mice were deeply anesthetized, and their spleens were removed. By real-time PCR, mRNA levels in the spleen were analyzed, with a focus on the master transcription factors of helper T (Th) cells.

Results: Repeated administration of OVA resulted in exacerbation of rhinitis symptoms and a marked increase in OVA-IgE levels. CTP administration prevented and treated the symptoms of rhinitis and reduced the OVA-IgE levels. Regarding therapeutic efficacy, rhinitis symptoms were alleviated for more than 4 weeks after cessation of CTP administration. In contrast, CP had no effect on rhinitis symptoms. Real-time PCR revealed that CTP decreased the activity of type 2 Th cells and of follicular helper T cells.

Conclusions: These findings suggest that CTP exerts an anti-rhinitis effect by restoring the Th-cell composition

Keyword: Collagen tripeptide, allergic rhinitis, IgE antibody, master transcription factor, helper T cell

Conflict of Interest Disclosure: Yasushi Hayashi received a research fund from Jellice Co., Ltd.

PAB(T7-294)
Metabolites Profile and Antioxidant Properties of Fermented-Strawberry Drink: Non-Targeted Metabolomic Profiling and *In Vitro* Study

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Background and Objectives: Strawberry or *Fragaria ananassa*, is a fruit rich in antioxidants and phytochemicals, which may have benefits for heart health, blood sugar control, and the ability to scavenge free radicals. The purpose of this study is to innovate strawberries into fermented drinks using the kombucha method or strawberry kombucha drink (SKD). Determination of metabolites profile and antioxidant activity of SKD was also carried out.

Methods: The ingredients of the SKD formula consist of 2,000 mL of water, 24 g of strawberry flesh, 300 g of cane sugar, 10 g of SCOBY gel, and 166 g v/v of SCOBY starter solution, bringing the overall total to 2,500 mL. After going through the usual cooking of kombucha, the material is stored in the bottle, then stored in anaerobic conditions (20 – 25 °C) for 12 days. This formulation was designed taking into account previous study formulations. After 12 days of fermentation, all beverage samples were stored at a refrigerator temperature of 4 – 8 °C for metabolomic profiling analysis by LC-HRMS and *in vitro* antioxidants using ABTS assay. ABTS Assay is used in concentration gradients of 50, 100, 150, 200, and 250 µg/mg of KSD, as well as Trolox as a control. Furthermore, data analysis on *in vitro* studies using independent sample T-test (CI: 95%; 0.05) and half maximal effective concentration (EC_{50}) using non-linear regression. The GraphPad Prism 9 Premium software was used in this regard.

Results: A total of 62 bioactive compounds were identified in SKD. The three high-abundance compounds in SKD are Theobromine ($C_7H_8N_4O_2$), Epicatechin ($C_{15}H_{14}O_6$) and Rutin ($C_{27}H_{30}O_{16}$). Based on the literature, the majority of these compounds exhibited several health benefits, ranging from antioxidant, neuroprotective, hypolipidemic, and protection against cardiometabolic risk factors. The ABTS inhibition activity of all doses of SKD is similar to Trolox (no significant difference; $p>0.05$). The EC_{50} value of SKD and Trolox regarding the inhibition of ABTS were 18.52 µg/mg and 19.61 µg/mg, respectively.

Conclusions: Based on this study, it can be concluded that Strawberries can be incorporated into a fermented kombucha drink (SKD) that has a metabolite profile and antioxidant properties with various health benefits as a functional food

Keyword: Strawberries, Antioxidants, Functional Food, Kombucha, Metabolites

Conflict of Interest Disclosure: None

PAB(T7-295)
Screening of citrus fruits on anti-atherogenic functionality of HDL

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Background and objectives: ATP-binding cassette transporters (ABC) A1, G1and cavenger receptor class B type I (SR-BI) are key molecules in cholesterol efflux from macrophages, which is an initial step of reverse cholesterol transport, a major anti-atherogenic functionality of high-density lipoprotein (HDL). Citrus fruit intake protects against cardiovascular disease, it remains unclear through what mechanism of action it affects cholesterol homeostasis in macrophages. We therefore investigated the effects of citrus fruit on HDL-mediated cholesterol efflux and expressions of key molecules in macrophages.

Methods: We investigated water-soluble and oil-soluble extracts of twenty-three types of citrus fruit. The differentiation of THP-1 monocytes into macrophages was induced in the presence of 320 nmol/L PMA for 72 hours. The macrophages were labeled with [3H]cholesterol (1.0 µCi/mL) in RPMI 1640 for

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

24 hours and incubated in the presence and absence of HDL (50 µg/mL) for 24 hours. The percentage cholesterol efflux was calculated by dividing the media-derived radioactivity by the sum of the radioactivity in the media and the cells.

Results: Among citrus fruits, six types of oil-soluble extracts from citrus fruit peel (blood orange, minneola orange, kumquat, kabosu, navel and citron) enhanced cholesterol efflux from THP-1 macrophages mediated by HDL. Furthermore, we found that limonene, the major component in the oil of citrus fruit peels enhanced cholesterol efflux from THP-1 macrophages mediated by HDL. In supporting these enhanced cholesterol efflux mechanisms, limonene increased the protein levels of ABCA1 and ABCG1, but not SR-BI.

Conclusions: The potential cardioprotective properties of citrus fruit peel might be associated with an enhanced anti-atherogenic functionality of HDL.

Keyword: cholesterol, macrophage, HDL, citrus fruits, limonene

Conflict of Interest Disclosure: None

PAB(T7-296)
Effects of Sea grapes Extract Supplementation on Cholesterol Changes in 7,12-dimethylbenz [a] anthracene-induced Rat Models

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Background and Objectives: Increasing cholesterol levels is associated with higher cancer risk. Cholesterol-lowering supplements – as a functional food – exhibit beneficial effects by reducing the risk and mortality of cancers. The Caulerpaceae family contains polysaccharide and bioactive components that have antioxidant, antibacterial, and anti-inflammation properties. Therefore, this research aimed to study the anticancer activity of Sea grapes (*Caulerpa racemosa*) that is associated with cholesterol levels on 7,12-dimethylbenz(a)anthracene (DMBA) induced breast cancer in rats.

Methods: Fresh Sea grapes were collected from the shallow waters of Mantehage, North Sulawesi, Indonesia. Sea grapes extract (SGE) was extracted using 96% ethanol for 72 hours. Fifty Sprague-Dawley male rats (4 weeks) weighing 200-250 g were divided into 5 groups (A = normal control; B = negative control; C = 2.7 mg/200gBW of SGE; D = 5.4 mg/200gBW of SGE; E = 10.8 mg/200gBW of SGE). All rats received a standard diet and *ad libitum* water. Rats from group B until D was given 80 mg/kgBW of DMBA ($C_{20}H_{16}$; PubChem CID: 6001) on the 38th day of life to induce mammary gland tumors. Carcinogenic agents dissolved in rapeseed oil were selected as DMBA senders. After 8 weeks, the rats were decapitated. Their blood was taken from the heart and liver, weighed, and stored at -80°C for further analysis. The research protocol refers to the Declaration of Helsinki and the Council for International Organizations of Medical Sciences (CIOMS) and has received internationally ethical approval (International Register of Preclinical Trials Protocols; PCTE0000283).

Results: There was a significant decrease in LDL levels along with an increase in the number of sea grape supplements given to the group. A similar tendency was also observed in the increase of HDL levels and the decrease of triglyceride levels. The value of total cholesterol in each group given SGE also showed a very significant difference when compared to group B. There was no significant difference in the value of every lipid profile between the groups given 5.4 mg/200gBW of SGE with the 10.8 mg/200gBW.

Conclusions: Supplementation of SGE may improve lipid profile conditions by altering cholesterol levels in DMBA-induced rats. SGE has the potential as a functional food against breast cancer.

Keyword: Cancer, Cholesterol, Caulerpa racemosa, Breast cancer, 7,12-Dimethylbenz [a] anthracene
Conflict of Interest Disclosure: None
Further Collaborators: None

PAB(T7-297)
Effect of one week of consumption of brown rice fermented food on postprandial blood glucose levels

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Purpose: We have reported that brown rice fermented food (FBR) has functional properties such as intestinal regulation, reduction of blood triglycerides, and antioxidant effect. We have also reported the effect of a single intake of FBR on the suppression of elevated blood glucose. In this study, we investigated the effects of one week of consumption of brown rice fermented food on the body in healthy adult women.

Methods: Five healthy young women were subjects. They consumed a brown rice fermented food (KAKUSAN Co., Ltd.) three times a day (3 g/treatment) for 7 consecutive days. Before and after consumption, dietary survey (FFQg), body composition, blood biochemistry test, stress measurement, intestinal bacteria test, and blood glucose level after rice ball consumption were measured. Blood glucose levels were measured at 9:00 a.m. on the morning of the measurement day, when the subjects consumed two rice balls (75.2 g carbohydrate) in a fasting state (fasted since 21:00 the previous day), and blood

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

glucose levels were then measured over time. Blood glucose levels were measured by the subjects themselves using a self-monitoring blood glucose meter (Roche DC Japan). Statistical processing was performed using SPSS Ver. 28, with a significance level of 5% or less. This study was conducted after ethical review by Kochi Prefectural University (Approval No.: 21-01).

Results: There were no significant changes in the subjects' nutritional intake, blood chemistry, stress status, or intestinal microflora before and after FBR intake. In the variation of blood glucose levels after consumption of rice balls, the increase in blood glucose levels was predominantly suppressed after consumption of FBR at 30 minutes and 120 minutes after the meal. The AUC was also predominantly lower after ingestion of FBR.

Conclusion: Although the single dose of FBR was found to suppress blood glucose, one week of continuous consumption of FBR significantly suppressed the increase in blood glucose level caused by onigiri consumption, although no change was observed in blood biochemical tests. Further investigation is needed to determine the inhibitory effect of FBR on blood glucose levels after one week of continuous consumption.

Keyword: brown rice fermented food, blood glucose, functional food

PAB(T7-298)
Effects of walnut milk beverage on gut microbiota in older adults with mild cognitive impairment: a pilot study

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Background and objectives: Growing evidence supports that gut microbiota can regulate brain function and influence cognition and basic behavioral patterns through bidirectional connections with the brain. Walnut is a commonly consumed nut that is regarded as a traditional medicine and food in China. The objective of this study is to evaluate the effect of walnut milk beverage on gut microbiota in older adults with mild cognitive impairment.

Methods: Participants aged between 60 and 85 years were recruited from a nursing home and were assessed cognitive and memory function according to the Montreal Cognitive Assessment (MoCA) and Mini-Mental State Examination (MMSE). Participants who were diagnosed with mild cognitive impairment (MCI) (n=27) were required to drink one bottle of walnut milk beverage daily for 8 weeks. To ensure the reliability of the test results of the gut microbiota, in addition to the first test period from November 2019 to December 2019, the same test was repeated a second time from December 2020 to January 2021. Before and after the test, fecal samples were collected from the participants for gut microbiota analysis, and 16S rDNA sequencing and analysis were performed to compare the differences in Gut Microbiota.

Results: The results revealed no statistically significant difference ($P > 0.05$) in the alpha diversity of gut microbiota between the baseline and after consumption of walnut milk beverage, but the abundance of *cyanobacteria* increased significantly at the phylum level ($P < 0.05$) after drinking walnut milk beverage. The Tax4Fun level 2 analysis of gut microbiota functional gene prediction revealed that immune system, nervous system, and γ- GABAergic synaptic were also increased after walnut milk beverage consumption ($P < 0.05$). Among them, there is a positive correlation between the changes of GABAergic synaptic and attention.

Conclusions: Drinking walnut milk beverage may enhance GABAergic synapse functions of older adults with MCI, potentially preventing attention decline resulting from aging.

Keyword: walnut milk beverage, mild cognitive impairment, gut microbiota, γ- GABAergic synaptic, memory and cognitive function

PAB(T7-299)
Improvement in processing of Mongolian traditional dairy product

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BACKGROUND. Mongolian traditional methods of processing milk have thousands years of history, and contain most achievements of modern sciences in accordance with milk content and characteristics of pasteurized animal products. We are interested in improving processing of dairy products, especially traditional products such as "Eezgii" (coagulated and evaporated dairy product).

PURPOSE. The transition from traditional milk production methods into industrial manufacturing methods are motivated by the growing number of urban population.

METHODS. Milk obtained from five different animals was used: camel, horse, cattle, sheep and goat. Milk produced by different animals varies in quality and composition. We have investigated processing of "Eezgii" by 3 different evaporation methods, to know: traditional, vacuum evaporation, and ohmic heating. The parameters for "Eezgii" processing are: coagulation method, temperature and time, as well as evaporation method, temperature, time and pressure. Ohmic heating is an advanced thermal process. Food is heated by passing electricity and ohm resistance.

RESULTS AND DISCUSSION. *Traditional method*: Coagulation started after 5 minutes at 82^{0}C. Coagulated milk contained 135,61 g of curd and 400 ml of whey. *Vacuum evaporation:* Coagulated milk was boiled at 70^{0}C, in the rotary vacuum

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

evaporator at 190 HPa. This process took 1 hour 40 minutes. After drying eezgii's weight was 31,71 g. *Ohmic heating*: The coagulated milk started boiling after 5 minutes processing (P=1 kW, V_{cons}=100 V); at this time the current value 4,35 A. This process finished after 31 minutes, at which time the current value was 0,6 A.

CONCLUSION: Based on the intensive study on "eezgii" processing, there are various possibilities to produce many kinds of highly nutritous milk products.

Ohmic heating process was the best evaporation method for decreasing processing time and increased "eezgii" productivity.

Most likely traditional evaporation will be replaced by to Ohmic heating processing in the future.

Keyword: evaporation, eezgii, ohmic heating, traditional method

Conflict of Interest Disclosure: None

Further Collaborators: No

PAB(T7-300)

The Effect of Galohgor Nutraceutical on Fasting Blood Glucose of Type 2 Diabetes Mellitus Subjects

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Background and objectives: Galohgor Nutraceutical is a traditional poly herbal product from Indonesia containing antioxidant and other bioactive components which showed synergistic effect on controlling blood glucose in animal model. The aim of this study is to analyze the effect of Galohgor Nutraceutical on fasting blood glucose level of type 2 diabetes mellitus subjects. Methods: This study used experimental trial with pre-post-controlled design and applied on 26 diabetics (Type 2 DM) subjects which were divided into two groups, i.e. intervention and control. The study was conducted at Bogor District, West Java, for 38 days intervention periods. The differences of fasting blood glucose between groups were tested by ANCOVA. **Results**: The result showed that adjusted mean difference of fasting blood glucose for cookies and powder drinks of Galohgor group compared with control group were -57.7% and -2.4% (p= 0.05). **Conclusions:** Galohgor nutraceutical significantly reduced fasting blood glucose in type 2 diabetes mellitus subjects.

Keyword: nutraceutical, diabetes mellitus, galohgor, hyperglicemia

PAB(T7-301)

Regulation of Pancreatic *Interleukin-6* and *TNF-α* Expressions in the Diet-Induced Obese Mice through Short Chain Fatty Acids Supplementation

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Background and objectives: Short chain fatty acids (SCFAs) have been reported to modulate inflammation through various molecular mechanisms and could regulate physiological functions *via* neuro-hormonal circuit interaction. The study investigated the effects of SCFAs on pancreatic interleukin-6 and tumor necrosis factor-alpha expressions. The effects of SCFAs on food intake, body weight and blood glucose in mice were also reported.

Methods: The *Il-6* and *TNF-alpha* expressions were quantified using qPCR and sandwich ELISA for the mRNA and protein concentration, respectively, and compared with the negative control.

Results: The results showed that all SCFAs can downregulate the IL-6 mRNA expression but not significant enough to reduce the expression ($p>0.05$). The pancreatic IL-6 protein expression exhibited significant reduction when treated with acetate, propionate, butyrate and mixed SCFAs. The SCFAs were found to induce significant downregulation on TNF-alpha mRNA expression. The TNF-alpha protein expression also showed significant reduction in acetate, propionate, butyrate and mixed SCFAs-treated groups. All SCFAs treatment were observed to have significant increase in food intake and body weight while only the acetate and propionate-treated groups exhibited increase in the blood glucose level.

Conclusion: In conclusion, different SCFAs treatment had different levels of effective regulation in IL-6 and TNF-alpha expressions especially at the protein level.

Keyword: Short-chain fatty acids, cytokines, interleukin-6, tumor necrosis factor-alpha, acetylation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-302)
Anti-obesity effects of the waste rice media of *Cordyceps militaris*

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Background and objectives: *Cordyceps militaris*, a dietary therapeutic fungus, is a potential candidate for obesity alleviation. The fruit bodies of *Cordyceps militaris* are medically and economically valuable, while the waste rice media of *Cordyceps militaris* are usually discarded after the harvest of the fruit bodies. However, the waste rice media of *Cordyceps militaris* seems to have medical activity. In this study, the anti-obesity activity of waste rice media of *Cordyceps militaris* was evaluated.

Methods: The contents of cordycepin, the major bioactive compound that contribute to the anti-obesity activity of *Cordyceps militaris*, in the waste rice media of *Cordyceps militaris* were determined by high performance liquid chromatography (HPLC). The waste rice media of *Cordyceps militaris* was evaluated for its anti-obesity effect on adipocytes using 3T3L1 mouse adipocytes and high fat diet-induced obese rats.

Results: The contents of cordycepin in the waste rice media of *Cordyceps militaris* was about one third of that in the fruit body of *Cordyceps militaris*, indicating that the waste rice media of *Cordyceps militaris* might possess medical activity. The water extract of the waste rice media of *Cordyceps militaris* strongly inhibited adipogenesis of 3T3-L1 pre-adipocytes by upregulating mRNA expression of AMPK and proteins that related to Wnt10b signaling pathway, and consequently inhibited mRNA expression of C/EBPα and PPARγ. The water extract of the waste rice media of *Cordyceps militaris* also reduced lipogenesis in mature 3T3-L1 adipocytes by inhibiting lipogenesis and promoting lipolysis. The oral administration of the waste rice media of *Cordyceps militaris* by high fat diet-induced obese rats significantly reduced the serum concentrations of triacylglycerol and cholesterol. Moreover, fat diet-induced obese rats showed severe hepatic steatosis, and this condition was alleviated by the oral administration of waste rice media of *Cordyceps militaris*. Gut microbiota analysis reveals a marked abundance of *Akkermansia muciniphila* and *Parabacteroides goldsteinii*, both of which are reported to reverse obesity and insulin resistance, in the waste rice media of *Cordyceps militaris* administrated rats.

Conclusions: These results suggest that *Cordyceps militaris* spent rice media has a potential to be used in the treatment of obesity.

Keyword: Cordycepes militaris, cordycepin, obesity

PAB(T7-303)
Vacuum dried mulberry leaf powder: A promising functional ingredient and its application in alginate beads

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Background and objectives: Mulberry (*Morus alba* L.) leaf has been consumed as tea and seasoning powder in many Asian countries. Additionally, it is a well-known folk medicinal plant which have various pharmacological activities. Mulberry 1-deoxynojirimycin (DNJ) is a biologically active natural compound that exhibits hypoglycemic effect. This study aims to compare the active compounds and biological activities of leaf powder after vacuum (VML) and sun (SML) drying process, and in food application.

Methods: DNJ and total phenolics (TP), *in vitro* α-glucosidase inhibitory, and antioxidant (FRAP and ORAC assay) activities of VML and SML were evalutated. The selected powder with high amount of the active compounds and the biological activities was further evaluated the potential applications in food by addition in alginate beads, and reduced the harmful microorganism using high pressure processing (HPP) at 100 and 300 MPa for 5 min. The final products were compared those parameters with non-treatment sample.

Results: Our results showed the vacuum drying process had overcome sun dry method. The content of active compounds and the *in vitro* health benefits of VML were greater than that of SML (DNJ 614.05 ± 40.82 921.88 ± 33.14 µg/g; TP 14.93 ± 0.82 and 11.95 ± 0.10 mg gallic acid equivalent (GAE)/g; percent inhibition of α-glucosidase 77.34 ± 1.00 and 66.36 ± 1.07; FRAP value 60.86 ± 1.32 and 56.48 ± 0.96 µmol trolox equivalent (TE)/g; ORAC value 748.32 ± 35.11 and 604.80 ± 31.45 µmol TE/g in VMB and SMB, respectively). The VML was selected, and added in the alginate bead system. The HPP either 100 or 300 MPa did not reduce active components and *in vitro* health benefits (DNJ 8.31-8.79 µg/g; TP 9.21-9.64 mgGAE/g; percent inhibition of α-glucosidase 62.49-65.93; FRAP25.75-28.70 µmol TE/g; ORAC 158.76-162.63 µmol TE/g).

Conclusion:s: In summary, vacuum dried mulberry leaf powder is a potent functional ingredient that can be applied in food for reduce blood glucose. Our result showed that the HPP prevents loss of the both active compounds and their function. For further study, the clinical trial of the products should be conducted in order to support the health benefit of final products.

Keyword: mulberry leaf, 1-deoxynojirimycin, phenolics, α-glucosidase inhibitory, antioxidant activity

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-304)
Analysis of the effect of coffee polyphenols on the prevention and/or improvement of renal fibrosis

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Background and objectives:In recent years, there is an urgent need to search for functional food ingredients that prevent and/or improve renal fibrosis, a complication of chronic kidney disease (CKD), but little has been done to date. In this study, we focused on coffee polyphenols such as chlorogenic acid (ChA) and its metabolites, caffeic acid (CA) and quinic acid (QA), and examined whether they have an inhibitory effect on renal fibrosis using cultured rat interstitial fibroblasts cells (NRK49F) and human tubular epithelial cells (HK-2).

Methods: NRK49F and HK-2 cells seeded at $1 \times 10_5$ cells and cultured for 1 to 2 days, added ChA, CA, and QA at final concentrations of 0, 50, 100, 200, and 400 µM and treat for 24 hours. To examine the effect of ChA, CA, and QA on cell survival, MTT analysis was performed. Total RNA was extracted from these cells, and real-time PCR was performed. The genes examined were smooth muscle actin (α-SMA) and collagen 1a1 (Col1a1), which are fibrosis marker proteins, and transforming growth factor (Tgf)- β1, β2, and β3, renal fibrosis-inducing factors. GAPDH was used as an internal standard. In addition, the same analysis was performed under the conditions in which these cells were stimulated with TGF-β to induce fibrosis.

Results: The results of MTT analysis in NRK49F cells showed a decrease in ChA and CA. Next, the gene expression levels of α-SMA and Col1a1 in NRK49F cells found no significant changes for ChA and QA, but a concentration-dependent decrease in Col1a1 gene expression for CA. Tgf-β1 and β2 gene expression levels were not affected, but a significant decrease in Tgf-β3 gene expression level was observed with the addition of 400 µM of CA. On the other hand, in HK-2 cells, neither cell survival nor the above gene expression levels were affected by the addition of ChA, CA, or QA. Addition of CA to TGF-β-stimulated NRK49F resulted in a significant decrease in α-SMA and Col1a1 gene expression.

Conclusions: These results suggest that CA may have an inhibitory effect on renal fibrosis induction in a renal interstitial fibroblasts cell-specific manner.

Kyword: renal fibrosis, chronic kidney disease, caffeic acid, chlorogenic acid, quinic acid

PAB(T7-305)
Search for inhibitors of advanced glycation end products formation from brown algae, *Sargassum macrocarpum* and *Ecklonia stolonifera*

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Background and objectives: Advanced glycation end products (AGEs) are general group of compounds formed by non-enzymatic reactions between proteins and sugars. The accumulation of AGEs has revealed an association with diabetes, aging, neurodegenerative disease and many other diseases. Discovery of the AGEs formation inhibitors is important to prevent these diseases. To search for inhibitors of advanced glycation end products formation, we screened 18 seaweeds collected in Ishikawa prefecture. As a result of screening, brown algae, *Sargassum macrocarpum* and *Ecklonia stolonifera* were found to have strong inhibitory activity. Therefore, we carried out a search and evaluation of inhibitor from these two brown algae.

Methods: Brown algae, *S. macrocarpum* and *E. stolonifera* were collected at the coast of the Noto peninsula in Ishikawa prefecture. Collected brown algae were washed, dried, and extracted using EtOH. Sequentially, the extracts were purified using normal and reversed-phase chromatography, and reversed-phase HPLC. Isolated compounds were elucidated using NMR spectral analysis. The AGEs formation inhibitory and the DPPH radical scavenging activity of isolated compounds were examined and the structure activity relationship was studied from the results.

Results: As a result of searching for compounds with AGEs inhibitor, 12 meroterpenoids including one new meroterpenoid were isolated from *S. macrocarpum* and 7 phlorotannins were isolated from *E. stolonifera*. All isolated compounds showed AGEs inhibitory activity but trends were different from the DPPH radical scavenging activity. Comparing the AGEs inhibitory activity of phlorotannins, it was observed that the larger number of penta-substituted benzenes had higher activity of the AGEs formation inhibitory. Furthermore, evaluating model compounds of phlorotannins, it was inferred that AGEs formation inhibitory activity was stronger when electron-rich groups were present because of the addition of many oxygen atoms to the phlorotannins

Conclusion: Search for inhibitors of advanced glycation end products formation from brown algae, *S. macrocarpum* and *E. stolonifera* 12 meroterpenoids including one new meroterpenoid and 7 phlorotannins were isolated. As a result of comparing structure-activity relationships of AGEs inhibitors, it was inferred that electron density of the benzene ring is important for the inhibition of AGEs formation by phlorotannins.

Keyword: advanced glycation end products, meroterpenoid, phlorotannin, Sargassum macrocarpum, Ecklonia stolonifera

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-306)
Regulation of Nutritional Preference for Macronutrients by Orally Administered Specific Amino Acids

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Background and objectives: Nutritional preferences for macronutrients are significant components of modulating eating behavior. It is well known that Dietary protein intake correlates to appetite, but the relationship between amino acids (AAs) intake and preference for macronutrients remains unclear. In this study, we examined the screening test to identify the novel function of AAs to modulate nutritional preference for macronutrients in licking tests. A feeding test was also performed to confirm the results of the licking test.

Methods: In Experiment 1, eight C57BL/6 mice trained for the licking test for one week with a 5% sucrose solution were used. Twenty amino acid (AA) solutions (AA1~AA20) were prepared by dissolving them in water or 0.1% CMC. As controls, saline or saline with 0.1% CMC was used. AA solutions (1 g/10 mL/kg) or controls were orally administered 30 min before the licking test of 10 min. The solution for the licking test was 5% soybean oil (FAT), 5% sucrose (CHO), or 1% umami solution (PRO). In Experiment 2, eight mice were administered AA2 (1 g/10 mL/kg) or control, and dietary intake of 45% high-fat diet was measured for 60 min.

Results: In Experiment 1, oral administration of AA1 decreased lick rate of FAT, CHO, and PRO ($P< 0.05$). AA20 increased lick rate of FAT, CHO, and PRO ($P< 0.005$). AA19 increased lick late of FAT, and PRO ($P<;0.005$). AA2 decreased lick rate of FAT ($P<;0.005$). AA5 increased lick rate of CHO, PRO ($P< 0.05$). In Experiment 2, the feeding rate of a high-fat diet was significantly suppressed by oral administration of AA2 in accordance with the licking test($P< 0.05$).

Conclusions: In conclusion, we found five AAs that modulate nutritional preference for macronutrients in the licking test. The feeding rate of a high-fat diet was significantly suppressed by AA2. The feeding tests of other four AAs are ongoing.

Keyword: Amino acids, Preference, Appetite, Oral administration, Licking test

PAB(T7-307)
Search for proteins that inhibit postprandial blood glucose elevation in rice bran and various rice varieties.

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Background and objectives: For the prevention of diabetes mellitus, it is effective to suppress or retard the increase in postprandial blood glucose levels. Previously, we showed that a non-digestible 16 kDa protein (REA) contained in the albumin fraction of japonica rice endosperm suppressed the postprandial increase in blood glucose levels. REA adsorbed glucose like dietary fiber and inhibited glucose absorption from the small intestine. In this study, we investigated whether proteins similar to REA could be obtained from other parts of rice or from other rice varieties, and have a suppressive effect on postprandial blood glucose elevation.

Methods: Albumin was extracted from japonica rice red-bran, japonica rice middle-bran, polished indica rice, and polished javanica rice. The presence of 16 kDa protein in albumins and the tolerance to digestion by pepsin and trypsin were evaluated by SDS-PAGE. In addition, the glucose adsorption capacity of albumins was evaluated using a dialysis membrane unit. Albumin with the highest glucose adsorption capacity was subjected to a glucose tolerance test (OGTT) in rats, and blood glucose and plasma insulin levels were measured. The 16 kDa protein in the albumin was subjected to LC-MS/MS analysis to see if it was identical to REA.

Results: The presence of 16 kDa proteins was confirmed in all samples, and they were resistant to digestion except for red-bran albumin. The glucose adsorption capacity was also confirmed in all samples, middle bran showing the highest value. Oral administration of middle-bran albumin with glucose in the OGTT suppressed rapid elevation of blood glucose and insulin levels. The 16 kDa protein obtained from the middle bran was identified to be the same as that from japonica rice endosperm by LC-MS/MS with the high coverage value.

Conclusions: Middle-bran albumin, wasted after polishing rice, is expected to be used as a less expensive food material that can suppress elevation of the blood glucose levels.

Keyword: Rice

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-308)
Blueberry stem extract prevents lacrimal hyposecretion in Sjögren's Syndrome-like model of non-obese diabetic mice

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Background and objectives: Sjögren's Syndrome (SS) is an autoimmune disease that causes dry eye and dry mouth symptoms. Since SS progresses gradually with aging after onset, it is necessary to establish methods for prevention and/or care of SS from an early stage. Functional foods possess preventive effects against some diseases; additionally, it is safe that we can continuously take them on a daily. In recent years, in Miyazaki, Japan, blueberry stems have been cultivated, and blueberry stem water extract (BSE), which contains polyphenols such as proanthocyanidins, catechins, chlorogenic acid, and rutin, has been studied for the development of health food material. However, no research about BSE has been conducted on eye health. The purpose of this study was to evaluate the effect of BSE on SS-like lacrimal hyposecretion in non-obese diabetic (NOD) mice.

Methods: Male NOD mice were fed diets containing 1% BSE or regular AIN-93G diets for 6 weeks. After pilocarpine I.P. injection under anesthesia, the tear secretion volume of mice was measured using a thread impregnated with phenol red. The length of the part where the color changed due to the tear was evaluated as the amount of tear secretion. The lacrimal glands of mice were collected for histological evaluation, measurement of inflammatory cytokines, IL-6, TNF-α, and IFN-γ, by ELISA, and detection of proteins by Western blotting.

Results:The tear secretion of NOD mice administered with BSE mixed diet was increased at 4 and 6 weeks. Infiltration area and inflammatory cytokines, IL-6 and IFN-γ, were decreased in the lacrimal gland tissue of BSE-treated mice. BSE administration also reduced autophagy-related protein ATG5, which is needed for SS progression. It prevented the downregulation of phosphorylated AMPK, which is involved in the regulation of inflammation in SS and other autoimmune diseases.

Conclusions: In the present study, continuous administration of BSE from the early onset of SS in male NOD mice suppressed inflammation and improved lacrimal secretory function. Further study of the immunomodulatory function of BSE administration is needed in the future.

Keyword: Sjögren's Syndrome, blueberry stem extract, lacrimal gland, tear secretion, inflammation

Conflict of Interest Disclosure: Funding and provision of experimental material in this study from Biolabo Co., Ltd.

PAB(T7-309)
Blueberry stem extract prevents endoplasmic reticulum stress on blue light-induced retinal photoreceptor cell damage *in vitro*.

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Background and objectives: Our eyes are exposed daily to a variety of light. Blue light, which is a high-energy visible light, unlike ultraviolet light, reaches the posterior retina, and it causes photoreceptor cell damage. For this reason, blue light is associated with the onset and progression of age-related macular degeneration. The retinal cell damage caused by blue light exposure involves not only oxidative stress but also endoplasmic reticulum (ER) stress. In this study, we investigated the protective effects of blueberry stem water extract (BSE) and its active ingredients against blue light-emitting diode (LED) light-induced ER stress-related apoptosis of retinal photoreceptor cells *in vitro*.

Methods: Cultured murine retinal photoreceptor (661W) cells were seeded in 96-well plates, and cells were treated with BSE and *N*-acetyl-L-cysteine (NAC), which is an antioxidant as a positive control. After 24 h incubation, cells were exposed to 500 lx blue LED light (wavelength 470 nm) for 24 h. At the end of blue light exposure, cell death, apoptosis, and reactive oxygen species (ROS) were detected by fluorescent dye. Additionally, we performed Western blotting to detect the expression of mitogen-activated protein kinase (MAPK) and endoplasmic reticulum (ER) stress-related proteins.

Results: BSE prevented photoreceptor cell death and apoptosis induced by blue light in a concentration-dependent manner. ROS production and phosphorylation of p38 MAPK and c-Jun N-terminal kinase (JNK), which are related to apoptosis as a stress response to blue light exposure, were suppressed by BSE treatment. Furthermore, BSE increased the expression of ER-phagy markers, FAM134B and LC3, and it suppressed ER stress proteins, Bip and ATF4 expressions.

Conclusions: Our results newly show that BSE prevents blue light-induced photoreceptor cell apoptosis through suppressing the endoplasmic reticulum stress signaling pathway.

Keyword: blueberry stem, polyphenol, photoreceptor, blue light, endoplasmic reticulum stress

Conflict of Interest Disclosure: Provide of experimental material and funding in this study from Biolabo Co., Ltd

PAB(T7-310)
Taurine Alleviated Hepatic Steatosis in Oleic Acid-Treated-HepG2 Cells and Rats Fed a High-Fat Diet

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Background and objectives: Non-alcoholic fatty liver disease (NAFLD) is a widespread chronic liver disease defined predominantly by steatosis (triglyceride (TG) accumulation), but there is no approved pharmaceutical treatment. Taurine is an amino acid that has been proven in many trials to alleviate the symptoms of NAFLD. Here we investigated whether the protective effect of taurine against steatosis involves the modulating of AMP-activated protein kinase (AMPK) and insulin signaling pathway.

Methods: The steatotic HepG2 cell model, established with 0.05mmol/L oleic acid, was treated with 5mmol/L taurine and/or 10μmol/L dorsomorphin for 24h. Sprague Dawley rats were divided into 6 groups: control group (regular diet), model group (high-fat diet), and their corresponding high/low dose taurine groups (70 and 350 mg/kg BW/d). All treatments were conducted for 8 weeks.

Results: In steatotic HepG2 cell model, taurine significantly reduced the TG concentration and protein expressions of sterol regulatory element binding proteins-1c (SREBP-1c), peroxisome proliferators activated receptor γ (PPARγ), fatty acid synthase (FAS), acetyl CoA carboxylase (ACC), stearoyl-CoA desaturase1 (SCD1). With taurine supplementation, phosphorylation of mammalian target of rapamycin (mTOR), insulin receptor substrate 1 (IRS1) (Ser302) was decreased and phosphorylation of AMPKα, liver kinase B1 (LKB1), phosphatidylinositol 3 kinase (PI3K), protein kinase B (Akt), ACC was increased. However, the TG-lowering effect of taurine in steatotic HepG2 cells was eliminated by the supplement of AMPK inhibitor- dorsomorphin. In animal experiments, taurine reduced liver and serum TG, as well as serum ALT, AST, IL-1β, IL-4 and TNF-α in rats fed a high-fat diet. The effects of taurine on the main enzymes and regulatory factors in TG synthesis were consistent with most results in steatotic HepG2 cell experiments.

Conclusions: Taurine alleviated the inhibition of IRS1-PI3K-Akt pathway caused by steatosis, and reduced hepatic steatosis by activating LKB1-AMPKα pathway, suppressing mTOR, SREBP-1c and PPARγ.

Keyword: Taurine, AMP-activated protein kinase, Triglyceride

PAB(T7311)
Kudzu and foxglove roots extract improves metabolic dysfunctions through microbiome composition change in Korean menopausal women: A randomized, placebo-controlled trial

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Background and objectives: Kudzu (*Pueraria lobata)* is known as an important source of puerarin, an isoflavone compound. The dried root of foxglove (*Rehmannia glutinosa*) is among the most common ingredients to combine with kudzu to have complementary effects. Ovariectomized-induced rat studies reported that kudzu and foxglove roots extract (KF) supplementation could affect bone turnover rate and insulin resistance. However, its effect on humans has not been investigated. So, this study aimed to evaluate the effects of KF on menopausal metabolic changes in women associated with microbiome composition alteration.

Methods: In this randomized, placebo-controlled, double-blind trial, 75 menopausal women aged 45 to 70 were enrolled and assigned to receive either a placebo or low-dose (0.63 g/day) or high-dose (0.95 g/day) for 12 weeks. Out of 61 subjects who completed the 12-week intervention, 50 (25 in the placebo group and 25 in the high-dose KF group) were analyzed for 16S rRNA gene-based metagenomics in urine. To test differences in 32 clinical features between two groups, we accurately predicted whether subjects were treated with KF using the least absolute shrinkage and selection operator (LASSO)-panelized logistic regression model. The differential genera between groups that showed significant results in at least 4 out of 7 statistical methods were determined, and the correlation with the selected clinical markers was confirmed. Different functional Kyoto Encyclopedia of Genes and Genomes (KEGG) pathways between groups were predicted through the Tax4Fun analysis.

Results: LASSO-panelized logistic regression model selected 17 clinical features, including body weight, C-terminal telopeptides of type I collagen (CTX), asymmetric dimethylarginine, and high-density lipoprotein cholesterol (HDL-cholesterol). In metagenomic analysis, the relative abundances of 16 genera were significantly different between groups. Spearman's correlation between 17 clinical features and 16 altered genera showed that CTX and HDL-cholesterol had negative correlations with *Lachnospiraceae* NC2004 group and *Escherichia-Shigella*, respectively. Moreover, functional prediction determined that three KEGG pathways in amino acid metabolism and two in xenobiotics biodegradation were different between groups.

Conclusions:The KF supplementation for 12 weeks may improve bone, vascular, and lipid-related metabolism in menopausal women by altering microbiome composition.

Keyword: isoflavone, menopause, microbiome, human clinical trial

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-312)
Enhanced immunity and hematopoietic function of *Litsea japonica* fruit extract in cyclophosphamide-induced immunosuppressed mice

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Background and objectives: Because the immune system plays a role in protecting the body from harmful substances and invasions, immune function is important for maintaining a healthy physiological state. Therefore, natural compounds that modify immune responses have attracted great interest for many years. This study was conducted to investigate improved activity of immunity and hematopoetic function of *Litsea japonica* fruit extract (LJFT) as a potential functional food.

Methods: The immunity-stimulating activity was observed in BALB/c mice supplemented with LJFT at low, medium, and high dosage for 7 days after administration of cyclophosphamide

Results: Our results showed that LJFT treatment significantly improved the spleen injury score and body weight change in cyclophosphamide-stimulated mice. The spleen-derived lymphocytes analysis demonstrated that numbers of $CD4^+$ and $CD8^+$T cells were notably enhanced by approximately 2-fold in the spleen of mice treated with high dosage of LJFT. In mice splenocytes differentiated into T and B lymphocytes, LJFT significantly induced proliferations. Furthermore, in hematopoietic analysis, LJFT significantly recovered numbers of white blood cells, red blood cells, and platelets. By an enzyme-linked immunosorbent assay analysis, serum levels of immune-related cytokines of tumor necrosis factor-α, interleukin (IL)-1β, IL-6, IL-2, and IFN-γ were notably recovered. In addition, serum levels of immunoglobulin (Ig) A, IgM, and IgG were restored by LJFT treatment.

Conclusions: Although further investigation is needed on the underlying mechanism of LJFT that stimulates immune function, this study has provided a reference for the development of *L. japonica* as a source material applied in functional foods to improve human immunity and hematological function

Keyword: Litsea japonica, immunity, hematopoetic function, cytokines, mice

Conflict of Interest Disclosure: None

PAB(T7-313)
Inhibitory effect of mixed tea of mulberry leaves and water chestnuts on postprandial blood glucose elevation

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Background and objectives: Since postprandial hyperglycemia is a risk factor not only for diabetes but also for arteriosclerosis, it is necessary to suppress the rapid rise in blood glucose levels after a meal. Mulberry leaves contain 1-deoxynojirimycin, which is known to inhibit α-glucosidase. On the other hand, we have shown that polyphenols in the husk of water chestnuts inhibited elevated blood glucose levels. In this study, we developed mixed tea of mulberry leaves and water chestnuts (mulberry-water chestnut tea), and investigated its effect on postprandial blood glucose elevation in humans with elevated blood glucose levels

Methods: The study subjects were 30 people (43.9 ± 8.4 years old, 21 males and 9 females) with fasting blood glucose levels of 100 to 126 mg/dL or hemoglobin A1c levels of 5.6 to 6.5%, randomly assigned to two groups. The tea used in the study was a mixture of mulberry leaves and the husk of the Japanese water chestnut (*Trapa japonica*) grown in Kanzaki, Saga, Japan. The total polyphenol and 1-deoxynojirimycin contents in the tea were 87.3 and 10.2 mg, respectively. The study was a randomized, placebo-controlled, double-blind, crossover comparative study. Subjects drank 200 ml of mulberry-water chestnut tea or placebo tea after taking blood on an empty stomach and immediately consumed 200 g of cooked rice. Subjects had their blood drawn 30, 60, 90, and 120 minutes later, respectively. Blood glucose and insulin levels were then measured.

Results: Mulberry-water chestnut tea significantly suppressed the increase in blood glucose levels 30 and 60 minutes after the meal compared to placebo tea. Mulberry-water chestnut tea was found to significantly suppress the rise in insulin at all postprandial times. In addition, the highest blood glucose and insulin levels were significantly lower in the mulberry-water chestnut tea group than in the placebo tea group. The time to reach maximum blood glucose concentration was also significantly delayed in the mulberry-water chestnut tea group compared to the placebo group.

Conclusion: Mulberry-water chestnut tea was suggested to be effective as a food ingredient for suppressing the increase in postprandial blood glucose levels in humans with elevated blood glucose levels.

Keyword: Mulberry leaves, Water chestnut, Inhibition of blood glucose elevation, Human clinical study, Polyphenol

Conflict of Interest Disclosure: This study was supported by a grant from Kanzaki City, Saga, Japan.

PAB(T7-314)

Ethyl acetate extract of bitter melon enhances serum clearance and muscle uptake of dietary triglyceride in rats

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Background and objectives: Bitter melon (*Momordica charantia*, BM) is a tropical and subtropical vine of Cucurbitaceae family. In addition to the culinary use, BM is traditionally used in medical herb for the treatment of diabetes mellitus in some countries. We recently reported that dietary BM elevated respiratory exchange ratio in the proper exercise performance in adult healthy men, suggesting that BM contains some active components to enhance lipid oxidation. In this study, we analyzed the effects of these active components on lipid metabolism in rats

Methods: We fractioned BM by using ethyl acetate (EE) and water (WE) to isolate active component(s). Triglyceride concentration and fatty acid composition of EE were determined. EE was further fractioned using silica gel column and HPLC. The major component estimated as triterpene glycoside was analyzed by NMR spectroscopy. Sprague-Dawley rats, weighing 300 g were fasting for 12 h, and followed by oral injection of 0.75 g/kg BW of BM powder or WE, or 0.375 g/kg BW of EE. After 0.5 h, rats were orally injected 15 ml/kg BW intralipos (10% soybean oil). Bloods were collected from the tail vein at 0, 1.5, and 2.5 h of the injection. At 2.5 h, gastrocnemius and soleus muscles were excised and determined serum and muscle triglyceride concentrations.

Results: Recoveries of EE and WE were 4.5% and 97.7%, respectively. Triglyceride concentration of EE was 48.8%, and the major fatty acid composition of EE was 52% α-eleostearic acid. From the result of NMR spectroscopy, the isolated major compound of triterpene glycoside of EE was identified as momordicoside K. While there were no differences of serum triglyceride concentration among 4 groups at 0 and 1.5 h, those in BM, EE and WE groups were significantly lowered than the control group at 2.5 h. Triglyceride concentrations of muscle in BM and EE groups were significantly higher than those of the control and WE groups.

Conclusions: There was a negative correlation, at 2.5 h, between serum and muscle triglyceride concentrations in rats injected BM and EE, but not WE, and major active components of EE were speculated as α-eleostearic acid and momordicoside K.

Keyword: bitter melon, ethyl acetate extract, serum triglyceride clearance, uptake of fatty acid by muscle, momordicoside K

PAB(T7-315)

The effect of inulin in a Jerusalem artichoke, *helianthus tuberosus* on postprandial blood glucose levels in healthy young women.

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Background and objectives: Inulin is one of soluble dietary fibers contained in such as agave, wheat and burdock. It has been reported that the soluble fiber has several effects on the human being, e.g. improving gut microflora and its immune system, and suppressing the absorptions of sugar and triglyceride through the intestine. However, there are few studies targeting adult young females. Therefore, we decided to investigate the effects of inulin on biochemical examinations, postprandial blood glucose fluctuations, defecation status, gut microflora, and physical stress markers in the women who ate commercially available inulin derived from Jerusalem artichokes for 1 week.

Methods: Seven healthy female volunteers (21-22 years, height 160.7±2.7 cm, body weight 54.4±6.4 kg, BMI 21.1±1.9 kg/m^2) were recruited. They ingested 0.8 g of inulin derived from Jerusalem artichokes before every three meals a day, which means they had total 2.4 g of inulin per day for a week. We analyzed laboratory data such as postprandial blood glucose levels, and assessed body composition, a physical stress by checking salivary IgA levels, and intestinal bacteria at both before- and after ingestions of inulin. Postprandial blood glucose levels were measured by meal load. For the glycemic load of a diet, the subjects ate two commercially available rice balls (78.2 g of available carbohydrate), and their blood glucose levels were monitored at an empty stomach (0 min) and 30, 60, 90, and 120 mins after ingestion. In addition, a dietary survey was conducted using the food intake frequency survey and lifestyle habit survey by FFQgVer.6 and the 24-hour recall method.

Results: One week of inulin ingestions did not show any significant changes in body composition and biochemical examinations at Before- and After ingestions. Postprandial blood glucose changes after eating rice showed significant reduction of the maximum blood glucose levels and the incremental area under the curve (IAUC) of blood glucose levels on 0 to 120 mins. In addition, improvements of both defecation frequency and stool appearance, and alternations of gut microflora were observed after ingesting inulin for a week.

Conclusions: We confirmed that continuous intake of inulin improved defecation conditions, altered the intestinal flora, and suppressed postprandial blood glucose levels. Further research on functional ingredients is required to be utilized in nutritional therapy and nutrition education in the near future.

Keyword: inulin, Jerusalem artichoke, postprandial blood glucose level

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-316)
Piceatannol inhibits fat accumulation by promoting phosphorylation of hormone-sensitive lipase

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Background and objectives: Piceatannol (PIC), one of the analogs of resveratrol, is a naturally occurring phytochemical and found to be contained in large amount in passion fruit (*Passiflora edulis*) seeds and known to have several beneficial effects such as antioxidant, anti-cancer, and anti-inflammatory activity. PIC also consists of a chemical structure like estrogen. In our previous study, we reported that PIC significantly suppressed visceral fat accumulation in ovariectomy mouse and found that the phosphorylation of hormone-sensitive lipase (HSL) in white adipose tissue was induced by PIC treatment. In this study, we investigated in detail the effects using 3T3-L1 adipocytes to clarify the mechanism by which PIC inhibits fat accumulation.

Methods: 3T3-L1 adipocytes were seeded in 6-well plates at 1×10^5 cells/well and induced to differentiate 2-day post confluency. The medium was changed every other day. Cells were differentiated for 6-10 days and subjected to each experiment. PIC was added to the medium at concentrations of 0, 25, or 50 µM with or without various agonists or antagonists. After extraction of total mRNA, expression levels of genes related to lipogenesis and lipolysis were measured by qRT-PCR. Phosphorylation of the protein was determined by Western blotting.

Results: At first, we confirmed that PIC reduced fat accumulation in 3T3-L1 as in OVX mice. PIC had no significant effect on lipogenesis-related genes expression. PIC promoted phosphorylation, meaning of activation, of HSL, an enzyme involved in lipolysis but not adipocyte triglyceride lipase (ATGL). This effect was not observed with RSV. Then, we investigated the mechanism by which PIC exerts its effect. The addition of PIC with propranolol, an antagonist of the β-adrenergic receptor, did not alter its action. However, when H89, an antagonist of PKA or G15, a selective antagonist of G-protein-coupled estrogen receptor (GPER) was added with PIC, phosphorylation level of HSL was lowered. In addition, PIC decreased the phosphorylation level of Akt, which is a downstream factor of insulin signaling.

Conclusions: It is suggested that PIC suppressed fat accumulation by promoting phosphorylation of HSL and that this effect may be mediated by GPER.

Keyword: Piceatannol, HSL, adipocytes, 3T3-L1, lipolysis

Conflict of Interest Disclosure: The authors have no conflicts of interest directly relevant to the content of this study

Further Collaborators: Piceatannol used in this study was provided by Research Institute, Morinaga and Company Ltd.,.

PAB(T7-317)
Dietary chrysin and quercetin ameliorate chemically induced colitis in mouse

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Objectives: The purpose of the study was to investigate the effects of chrysin and quercetin on the colonic damage and the levels of malondialdehyde in the organs of dinitrobenzene sulfonic acid (DNBS)-induced colitis in mice.

Methods: Male C57BL6/J mice were given chrysin (100 mg/kg, DC) or quercetin (100 mg/kg, DQ) while the control (CON) and DNBS groups were given vehicle every other day by oral gavage for 3 weeks. Then, colitis was induced by intra-rectal instillation of DNBS (4 mg per mouse) dissolved in 50% alcohol and the control mice were given the same volume of ethanol. The disease activity index (DAI) and body weight loss were measured from day 0 to 3 during DNBS treatment.

Results: All DNBS-treated mice resulted in a colitis characterized by weight loss, increased the score of DAI and loss of colonic architecture compared to the CON group. Chrysin attenuated the DNBS-induced colonic damage, as evidenced by the alleviation colon shortening and the decrease in mucin-producing goblet cells as well as the expression of MUC2. Besides, DC and DQ groups significantly reduced DNBS-elevated plasma interlukin-6, and malondialdehyde levels in the liver and ileum.

Conclusions:These results indicated that chrysin and quercetin could alleviate the colonic injury and oxidative stress in DNBS-induced colitis mice.

Keyword: Chrysin, Quercetin, Dinitrobenzene sulfonic acid, Disease activity index, Malondialdehyde

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Keyword: Inflammation, macrophages

PAB(T7-318)
S -1-propenylcysteine suppresses inflammation by promoting anti-inflammatory M2c-like macrophage polarization

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Background and objectives: Chronic inflammation caused by aging and unhealthy lifestyle can trigger the development of more severe diseases, such as atherosclerosis, type 2 diabetes and chronic kidney disease. Macrophage polarization into inflammatory M1 and anti-inflammatory M2, especially M2c type, is dependent on the tissue microenvironment, and the balance between M1 and M2 macrophages is important for the maintenance of immune homeostasis. In chronic inflammation, damage-associated molecular patterns (DAMPs) from dead cells shift the macrophage polarization into M1 type, leading to the persistent inflammation. We have previously shown that *S*-1-propenylcysteine (S1PC), the characteristic sulfur-containing compound in aged garlic extract, has a variety of beneficial actions including anti-inflammatory effect. In this study, we evaluated the action of S1PC on macrophage polarization and its detailed mechanism of action.

Methods: Senescence-Accelerated Mouse Prone 8 (SAMP8) mice were orally administrated 5 mg/kg S1PC for 6 weeks and the splenic lymphocytes were isolated. Bone marrow-derived macrophages (BMDMs) from C57BL/6J mice were cultured with LPS and IFN-γ, IL-4 or IL-10 in the presence of S1PC to polarize them into M1-, M2a- or M2c-like macrophages. Macrophage population and protein levels of both macrophage markers and IL-10R/STAT3 signaling pathway-related proteins in these cells were analyzed using flow cytometry, quantitative PCR and western blotting.

Results: We found that S1PC increased $CD11b^+$ $F4/80^+$ $CD206^+$ $CD86^-$ $CD150^+$ cells (M2c-like macrophages) and decreased $CD11b^+$ $F4/80^+$ $CD206^-$ $CD86^+$ cells (M1-like macrophages) in splenic lymphocytes of SAMP8 mice. In addition, S1PC also increased the production of M2c macrophage markers, arginase 1 and IL-10. *In vitro* studies, S1PC increased M2c-like macrophages by acting directly on BMDMs in the presence of IL-10, resulting in the decreased M1-like macrophages and pro-inflammatory cytokines compared to those treated with IL-10 alone. Next, we investigated the mechanism by which S1PC enhanced the number of M2c-like macrophages and found that this compound promoted the production of IL-10, which is essential for the M2c macrophage polarization, by maintaining STAT3 activation through inhibiting the interaction between IL-10Rα and its negative regulator SH2 domain containing inositol polyphosphate 5-phosphatase 1 (SHIP1).

Conclusions:These results suggest that S1PC exerts anti-inflammatory effect by promoting M2c-like macrophage polarization through sustained activation of IL-10R/STAT3 signaling pathway.

PAB(T7-319)
The potential of a polyphenol-rich pomegranate extract as a nutraceutical to suppress the microbial conversion of L-carnitine into trimethylamine

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Background and objectives: L-carnitine is an essential nutrient, found in red meat and metabolised by human gut microbiota to trimethylamine (TMA). In the liver, TMA is converted to trimethylamine N-oxide (TMAO), which it strongly associated with atherosclerosis and various cardiometabolic diseases. Previously suggested treatments to reduce TMAO are broad-spectrum antibiotics and 3,3-dimethyl-1-butanol (DMB), but these have adverse effects. Hence, we explored the effects of a pomegranate extract, naturally rich in polyphenols (e.g., ellagitannins and anthocyanins) that are thought to exert antioxidant and anti-inflammatory properties. In preliminary experiments, we found that anthocyanins reduced the conversion of another TMA precursor, choline, to TMA *in vitro*. Here, we aimed to explore the effects of a pomegranate extract on microbial L-carnitine metabolismo.

Methods: *In vitro* colon models were used, each comprising of a glass vessel that contained 1% fresh human faecal slurry from one of three separate donors. The models were inoculated with 2000 µM L-carnitine in combination with different doses of Dermogranate® pomegranate extract (5.7, 11.4, or 22.8 mg/mL). A control model with L-carnitine and without pomegranate extract was included for each donor. The models were maintained anaerobic (N_2 flow), at a controlled pH (6.6-7.1), and at 37 °C. Samples were collected at multiple time points over 48 hours and directly stored at -80 °C until further analysis. The samples were analysed for the concentration of L-carnitine, γ-butyrobetaine (γ-BB), TMA, and related metabolites, using LC-MS.

Results: The models that were treated with pomegranate extract showed slower formation of γ-BB compared with the control models in a dose-dependent fashion, with statistically significant differences at 8, 10, 12 and 20 hours after inoculation. In the control model, TMA appeared after 28 hours, while TMA did not appear in the pomegranate-treated models, with a statistically significant difference at 48 hours after inoculation.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conclusions: These findings demonstrate that the pomegranate extract suppressed L-carnitine conversion to the intermediate metabolite, γ-BB, and to TMA. This may subsequently reduce the levels of the proatherogenic TMAO. Prospectively, the use of pomegranate extract as a nutraceutical to suppress the microbial l-carnitine conversion to TMA needs to be further investigated in human studies.

Keyword: cardiometabolic disease, TMAO, pomegranate, ellagitannins, anthocyanins

Conflict of Interest Disclosure: None

PAB(T7-320)
Effect of Chrysanthemum morifolium extract on the postprandial glucose responses in subjects with abdominal obesity

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Background and objectives: Chrysanthemum morifolium is a medicinal plant of the Asteraceae family, that exerts a wide range of health benefits including anti-diabetes, anti-oxidants and anti inflammatory effects. This study aimed to investigate whether Chrysanthemum morifolium extract (CME) may exert beneficial effects on postprandial glucose response and related metabolic disorders in abdominal obesity.

Methods: A randomized, double-blind controlled trial was conducted in abdominally obese with metabolic abnormalities. Seventy-eight subjects were randomly assigned to receive either a placebo or CME (750 mg/day) for 12 weeks. We measured body composition, anthropometric measures, glucose biomarkers and lipid profile before and at the end of the trial. For the postprandial test, at 12 weeks, the subjects consumed a 75 g glucose with either a CME or placebo. Postprandial blood samples were collected 30, 60, 120, and 180 min afterwards.

Results: In postprandial response, the blood glucose levels peaked at 60 min in both groups and decreased steadily after peak in the CME group compared to the placebo group. Particularly, blood glucose level at 120 min was significantly lower in CME group. In fasting state, the level of HbA1c was slightly increased from baseline in the placebo group, it maintained unchanged in the CME group.

Conclusions:These findings suggest that CME supplementation may improve postprandial glucose response in subjects with abdominal obesity.

Keyword: Chrysanthemum morifolium, Obesity, Postprandial glucose response

PAB(T7-321)
Repeated supplementation of exogenous SOD can affect the endogenous antioxidant system as well as the microbial composition associated with oxidative damage.

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Background and objectives: Free radicals generated by various endogenous systems in our body cause redox imbalances and can lead to aging and degenerative diseases. Activation of superoxide dismutase (SOD), which is the first gateway of the antioxidative system, has been shown to protect the body from oxidative stress by boosting the redox cycle. However, since simple antioxidants research has been the major so far, evaluation of the effectiveness of SOD, an enzymatic antioxidant, is still insufficient. Therefore, the purpose of this study is to evaluate the effects of enzymatic antioxidants through changes in the antioxidant index and circulating microbiome according to long-term intake.

Methods: This study was designed as a randomized, double-blind, placebo-controlled in 80 healthy adults, and subjects consumed SOD (250 IU/capsule) or placebo daily for eight weeks. This study was designed as a randomized, double-blind, placebo-controlled in 80 healthy adults, and subjects consumed SOD (250 IU/capsule) or placebo daily for eight weeks. Functional indicators related to oxidative damage and antioxidant systems were evaluated using blood and urine samples collected before and after repeated consumption for 8 weeks. Also, the microbiome was analyzed by 16s NGS sequencing of blood and urine samples at the last visit.

Results: Endogenous antioxidant defense system and oxidative damage indicators were compared by considering the interaction between the group and time. Long-term intake of SOD activated antioxidant enzymes within the test group and remarkably decreased the level of oxidative damage markers, resulting in a difference between groups ($P < 0.05$). As a result of microbiome analysis, beta diversity analysis at the genus level showed differences between groups, and more than 15 critical genera with VIP scores > 1.0 and $P < 0.100$ were selected. And through the analysis of the relationship between clinical variables and microbiome at genus level, microorganisms such as *Gordonibacter*, *Peptoniphilus*, and *Slackia* showed a strong correlation with the enzymes in antioxidant system.

Conclusions: These findings suggest that repeated supplementation of SOD plays a role in altering the microbial composition, which can enhance the activity of endogenous antioxidant enzymes and mitigate oxidative damage.

keyword: cytokine modulator, assay system, screening

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T7-322)
Establishment of a simple screening assay system for identifying food-derived modulators of cytokine function

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Background and objectives: The signal transducer and activator of transcription (ST) family are cytokine-driven transcription factors that regulate various genes important for determining cell fates. The gain-of-function mutations in the *ST3* gene or the constitutively activated state of ST3 proteins cause several types of early-onset autoimmune diseases and cancers. These findings make ST3 an attractive target for disease intervention. This study aimed to develop an efficient screening system for identifying food-derived modulators of cytokine signaling.

Methods and Results: To search for molecules that modulate cytokine-driven ST3 activity, we established a simple and efficient cell-based screening assay system. HepG2 cells (hepatocellular carcinoma cells) were transfected with the luciferase reporter gene plasmid containing a ST3-binding site inserted upstream of the minimal *JUNB* promoter. The selected cell clone has superior cytokine dose-responsivity with a high signal-to-noise ratio. We established a stable assay by optimizing the parameters: culture plate, media, and normalization method. Several crude extracts of herbal plants or food, as well as purified natural ingredients, were screened for attenuation of cytokine-induced luciferase activity. Pretreatment with two carboxylic acid species at a dose of 50 µM attenuated reporter activity. Cytotoxicity was not observed under these assay conditions. Each carboxylic acid partially inhibited the expression of the cytokine-inducible ST3-target gene, phosphorylation levels of ST3, and nuclear translocation of ST3. We also discuss the mechanism of how these two carboxylic acids affect ST3 activity.

Conclusions: Altogether, our data indicate that the newly established screening system enables the identification of modulators of cytokine signaling.

Keyword: cytokine modulator, assay system, screening

PAB(T7-323)
Prebiotics and resistant starches from dietary pulses differently modulate gut microbiome and metabolic health in a humanized murine model of aging

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Background and Objectives: Dietary pulses, being a rich source of fiber and proteins, are an ideal food choice for older adults and offer an inexpensive way to promote gut and metabolic health. Pulses-derived resistant starches (RS) are relatively less explored prebiotic ingredients compared to cereals and tubers' RS with no research conducted in examining its gut modulatory potential in old age. We herein investigate prebiotic effects of pulses-derived RS on gut microbiome in aged, humanized mice colonized with human microbiota.

Methods: One-year-old 'germ-free' C57BL/6J male and female mice were colonized with human gut microbiota and divided into six groups: Western Diet (WD, control), WD supplemented with pinto-bean (RS1), blackeyed-pea (RS2), lentil (RS3), chickpea (RS4), and inulin (from chicory). Gut microbiome after 8-weeks intervention was measured using Illumina MiSeq platform and analyzed for taxonomic and diversity metrics using QIIME2 workflow (version 2020.6). Statistical analyses were performed with python libraries.

Results: RS 1-4 and inulin induced distinct microbiome signatures and these signatures further varied between male versus female hosts. Among groups, *Bacteroides*, *Blautia*, and *Parasuterella* were significantly ($P < 0.05$) abundant in inulin; *Parasutterella* in RS 2; *Dubosiella* and *Turicibacter* in RS 3; *Streptococcus*, *Odoribacter*, *UCG_010*, *Tuzzerellam*, and [*Eubacterium*] brachy_group in RS 4. Besides, nine taxa were significantly increased only upon treatment with RS4 compared to the control/inulin-groups. RS supplementation induced microbiota alteration in sex-dependent fashion, with males (Inulin and RS 2-4) and females (Inulin and RS4) had different microbial profiles and composition. Only RS 4 increased the microbial diversity in females. In control group, *Faecalibaculum* and *Dubosiella* were more abundant in females, while *Enterococcus* was more dominant in males. Interestingly, *Dubosiella* increased and become the most dominant taxa in males after inulin and RS2-4 administration whereas *Faecalibaculum* significantly decreased in females after inulin and RS4 treatment

Conclusion: These findings highlight unique patterns of gut microbiome modulation by different RS-types. RS4 consumption resulted in highest bacterial composition differences among all groups which were consistent among both sexes. The correlation of these alterations with host gut and cardiometabolic health (*data analysis in-progress*) will further shed light on the potential of RS for nutraceutical applications.

Keyword: Resistant starch, Pulses, Gut Microbiome, Prebiotics, Ageing

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-1)
Quantitative MALDI-MS imaging analysis of tissue accumulated food compounds by fluorescence-assisted spraying method

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Background and objectives: The application of matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS) imaging to quantitative analyses is limited due to variability of matrix amount and inhomogeneity of matrix crystal formation on tissue sections. Thus, in this study, we aimed to establish quantitative (q) MALDI-MS imaging using a MS ionizable fluorescent reagent to provide constant matrix spraying amount and to normalize variability of MS intensity of analytes.

Methods: Ferulic acid (FA) was used as target food compound in tissue. Rhodamine 6G (R6G, 40 µg/mL) and *O* dinitrobenzene *O* -DNB, 10 mg/mL) was added to matrix 1,5-diaminonaphthalene (1,5-DAN, 10 mg/mL). FA (20 pmol/0.2 µL spot) spotted on kidney tissue section from rats was analyzed by MS imaging (negative mode) using fluorescence-assisted matrix spraying method to obtain desired fluorescent intensity (40,000 a.u.). Kidney was taken 0, 15, 30, and 60 min after FA (50 mg/kg) oral administration to Sprague-Dawley rats.

Results: Among fluorescent reagents (R6G, 7-methoxycoumarin-3-carboxylic acid, naphthalene, and 6-carboxyfluorescein) used in this study, R6G was added to 1,5-DAN solution as MS ionizable fluorescent reagent to compensate matrix spray amount and normalize MS intensity. Furthermore, *O* -DNB was used as matrix additive to form uniform matrix crystals on tissue sections. At the spraying condition using R6G in 1,5-DAN solution containing *O*-DNB, reproducibility (RSD = 3.1%) and linearity (0.5–75 pmol/mm^2, R^2 = 0.9972) of relative MS intensity of FA were significantly improved compared to those of cycle-number-fixed spraying (40 cycles, RSD = 31.1%, R^2 = 0.9349). Then, tissue accumulated FA was visually determined to be 3.5, 3.0, and 0.2 µmol/g tissue at 15, 30, and 60 min after FA oral administration (50 mg/kg), respectively. Moreover, a linear correlation was observed between the present qMALDI-MS imaging and LC–MS results (R^2 = 0.9906, n = 3).

Conclusions: Quantitative MALDI-MS imaging was achieved successfully by fluorescence-assisted matrix spraying by R6G (MS normalizing standard) in 1,5-DAN solution containing *O* -DNB as matrix additive, which successfully quantified tissue accumulated FA in rat kidney after the oral administration.

Keyword: MS imaging, Bioavailability, Quantitative analysis, Visualization, Food compounds

PAB(T8-2)
Microbial loads in foods served and sold in Senior High Schools in Central Region, Cape Coast

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Background and objective: Improving the safety of cooked foods in School canteens is one of the ways of making foods wholesome for students who rely on this for their daily nutrient and energy supply. This study determined the microbial loads in foods served at dining halls and supplied points in sampled Senior High School (SHS) in the Cape Coast Municipality. **Methods**: The design was experimental, and convenience sampling was used to select four SHSs in the Cape Coast, Central Region. We sampled six frequently foods that are served to students during lunch breaks. Swabs from foods served in the canteen and from vendors and analyzed for microbial contamination based on the Codex Alimentarius Commission standards. Bacteria loads were separated into positive and negative gram and presented in CFU/g. We presented proportions for the number of microbes found in the foods and cooking materials. **Results**: Seven isolates were obtained from food samples and vendors. Most of the bacterial strains isolated were *Enterobacteriaceae* (71%). About 29% of the isolates were gram-positive bacteria (*Bacillus cereus*, and *Staphylococcus aureus*). Other types and amounts of isolates were: *Staphylococcus aureus* [canteen: (28-112CFU/g); vended: (23-84CFU/g)], *Bacillus cereus* [canteen:(8-34CFU/g); vended: (0-22CFU/g)] and *Corynebacterium spp.* canteen: (0CFU/g); vended(0-13CFU/g)]; **Conclusions**:Although the contamination was high, bacterial colonies found were within the safe limits of 150-300CFU/g, the amount of contamination is still high since students eat these foods on a regular basis in Cape Coast.

Keyword: Staphylococcus aureus , senior high school, food safety, Enterobacteriacaea, microbial load

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-3)
Current state of preserved foods for determining the cause of food poisoning while providing meals in Japan

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Background and objectives: At a Japanese mass-meal facility, it was decided to collect 50g of raw foods and cooked foods and store them at -20℃ for at least 2 weeks per specific hygiene inspection standards, which is especially important in the event of food poisoning (Ministry of Health, Labor and Welfare, 2005). After storage, food is often discarded, which poses the problem of food loss and waste, the prevention of which is one of the Sustainable Development Goals . This manual does not specify the details of the foods to be collected and the facility's measures required to select preserved foods. Therefore, the purpose was to investigate the foods that are preserved and those not preserved in the mass cooking facility, summarize the description contents, and use it as the basic data for collecting preserved foods.

Methods: Two registered dieticians searched for the terms "mass cooking" and "preserved food" or "food inspection" using the Google browser in manuals published on the Internet. The contents of 36 cases with detailed descriptions of 66 preserved food manuals that could be viewed, were organized.

Results: The most common manuals for preserved foods were of school meals, with 31 cases. Regarding foods that do not need to be preserved, there were many descriptions of cereals such as rice, wheat, canned foods, seasonings, and dried foods stored at room temperature. However, some manuals indicated collecting several seasonings and dried foods for preservation. In the case of collecting foods being less than 50 g per serving, different collection methods were mentioned in each manual.

Conclusions: Manuals differed in the foods for which preserved foods were collected (or not) and the amount of preserved foods collected.

Keyword: preserved food, mass cooking, food service, food sanitation, food loss and waste

PAB(T8-4)
Effects of pseudo-parasitic infection on mouse behavior

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Background and objectives: Recently, the relationship between intestinal parasites and physiological and mental states of host animals has been attracting attention, as exemplified by the fact that parasite *Toxoplasma gondii* induces change in behavior of host rodents. Throughout its evolution, human race has continuously been infected by and co-existed with numerous parasitic nematodes such as pinworm and tapeworms, which drive us to imagine that human behavior may also unawarely be affected by the coexisting parasitic nematode, just like the case of *Toxoplasma*-infected rodents. If so, the people in modern industrialized countries, who are mostly free from parasitic nematode, may have different behavioral pattern compared to people in the past when parasitis infection was more common. In this study, we hypothesized that the absence of parasites in modern humans has some effect on their mental and personality states, and attempted to test this hypothesis through behavioral analysis using “pseudo” parasite- infected mouse model.

Methods: We fed mice with non-infectious nematode *Caenorhabditis elegans*, which is used in molecular biology as model organism, for a long term to create a pseudo-parasite-infected state. By mouse intestine continuously exposed to the nematode-derived molecules and structures, we expected some aspect of parasite-infection was mimicked in this model. To measure the neurophysiological and behavioral changes between nematode-fed and control mice, hanging test, spontaneous running test, forced running test, and opposite-sex encounter test were conducted.

Results: There was no significant difference between the nematode-fed group and the control group in the hanging test, spontaneous running test, and forced running test, but in the opposite-sex encounter test, the nematode-fed group tended to spend less time in the opposite sex zone than the control group.

Conclusions:This experiment suggests that the presence or absence of parasites may have an effect on the sexual orientation and feeling of mice. This mechanism may be explained from the viewpoint of gut-brain communication, in which changes in the intestinal microflora caused by the administration of nematodes affect the brain. Therefore, we are analyzing the effects of *C.elegans* feeding on microbiota composition.

Keyword: Caenorhabditis elegans, parasite, behavior

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-5)
Effects of visual and aromatic stimulations on stress responses and taste perception.

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Background and objectives: Taste perception is affected by various environmental factors and plays a fundamental role in food selection. In the present study, we investigated the effects of visual and aromatic stimulations on stress responses and taste perception.

Methods: Fourteen young healthy participants were stimulated under five different conditions: normal (no stimuli), watching an action scene, watching a forest scene, sniffing a rosemary aroma, and sniffing a lavender aroma. The participants were assessed for their psychological and physiological stress response and suprathreshold taste intensity of five fundamental tastes before and after stimulation

Results: Compared to participants under the action scene condition, participants under the forest scene or under the rosemary aroma condition showed significantly lower stress levels. Furthermore, the forest scene condition significantly increased the saltiness intensity, whereas the rosemary aroma condition significantly increased the bitterness intensity. A positive or negative correlation was observed between the stress level and taste intensity of sourness and saltiness, respectively. Specifically, watching forest scenes significantly increased salt taste intensity, and the participants' stress levels were associated with salt taste intensity.

Conclusions: These findings indicate that visual image and aroma have the potential to change taste perception as well as modulate stress conditions.

Keyword: taste intensity, saltiness, visual image, aroma, stress condition

PAB(T8-6)
Edible insect migratory locust *Locusta migratoria*) is not only an alternative protein resource but also a potential candidate for improving agent of lipid metabolism

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Background and objectives: The world's population is estimated to reach 9.7 billion by 2050. This growing global population will require available resources to meet the nutritional needs of human health. Edible insects are increasingly recommended as novel sustainable food resources for human, but their nutritional and functional properties have not been fully evaluated. Migratory locust (*Locusta migratoria*), a representative edible insect, has been recognized as a novel food material by the European Food Safety Authority on 2021. If nutritional and functional properties are more clarified, migratory locust is expected to be developed as valuable and sustainable food resources. We have clarified that the migratory locust powder (MLP) contained rich in proteins, n-3 lipids (triglycerides and several kinds of phospholipids with α-linolenic acid), polyphenols, and indigestible fiber chitin, which are improving lipid metabolism. Here, dietary effects of MLP on lipid metabolism were investigated in rats.

Methods: The MLP, which was produced in Thailand and commercially sold in Japan, was used for the study. The 5-weeks-old male Wistar rats were fed with the casein (AIN-93G containing 20% protein and 7% fat) or MLP diet for 5 weeks. The MLP diet contained 10% MLP in AIN-93G diet. Growth efficiency and nutritional and biochemical parameters in the plasma, liver, and adipose tissues were investigated.

Results: Dietary MLP represented the favorable growth and improvement effect on hepatic lipid metabolism. Dietary MLP suppressed plasma lipid levels and low-density-lipoprotein (LDL) levels by upregulating liver LDL-receptor expression and suppressing proprotein convertase subtilisin kexin 9 (PCSK9) activity. Dietary MLP also altered fatty acid profile in the plasma, liver, and adipose and suppressed plasma arteriosclerosis-related factors. Additionally, dietary MLP downregulated the liver *de novo* lipogenic protein expressions and enzyme activities, leading to the improvement of liver function related factors. These findings can be comparable to the effects of statin, a dyslipidemia improving agent. N-3 lipids among several kinds of functional ingredients in MLP are mainly considered to contribute to the improvement of hepatic lipid metabolism.

Conclusions: MLP is expected as valuable and sustainable food protein and lipid resources with functionality and safety.

Keyword: Edible insect, Migratory locust, Lipid metabolism, Liver, N-3 fatty acid

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-7)
Effect of Ashitaba on the physical properties and allergenicity of bread

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Background and objectives: *Angelica keiskei* Koidzumi (Ashitaba) is a large perennial herb native to the Southeast Pacific coast of Japan. Ashitaba contains abundant dietary fiber, vitamins, potassium, and polyphenols, such as chalcones and coumarins, and is expected to have a preventive effect on lifestyle diseases. We are developing Ashitaba bread as a functional food. The number of patients with food allergies is increasing in Japan and wheat is often the cause of these allergies. The objective of this study was to evaluate the effect of Ashitaba powder on the physical properties and allergenicity of bread.

Methods: Control bread and Ashitaba bread in which 5% of the bread flour in the control bread was replaced with Ashitaba powder were prepared using a bread machine. The specific volume and compressive strength were measured, and the hardness of each bread was evaluated. Allergenicity was evaluated by western blot assay and dot-blot assay using the gliadin fraction extracted from each type of bread and analyzed using ImageJ (analysis software).

Results: Ashitaba bread was significantly harder compared with the control bread because of its lower specific volume ($p < 0.05$) and higher compressive strength ($p < 0.05$). It was considered that the dietary fiber contained in Ashitaba inhibited the swelling of the bread. In the evaluation of allergenicity using the western blot assay, high molecular weight gliadin was detected in Ashitaba bread. A dot-blot assay was used to detect gliadin that had retained its tertiary structure, the value of the band for this gliadin was significantly lower in Ashitaba bread, compared with the control bread. It is possible that the addition of Ashitaba affected the reactions between sugars and proteins, including the Maillard reaction, and changed the properties of the wheat protein, making the gliadin fraction less extractable, and resulting in reduced allergenicity.

Conclusions: The addition of Ashitaba powder to bread may make the bread harder and reduce the allergenicity.

Keyword: Ashitaba, Bread, Physical properties, Allergenicity

PAB(T8-8)
Inhibition of growth and staphylococcal enterotoxin A production by *Staphylococcus aureus* in cooked rice and rice balls containing sodium chloride, vinegar, and commercial seasonings.

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Background and objectives: In Japan, staphylococcal food poisoning often occurs in rice balls made at home. Salt and commercial seasonings are usually used for making rice balls. The purpose of this study was to estimate the effect of sodium chloride (NaCl) on the growth of *Staphylococcus aureus* and staphylococcal enterotoxin A (SEA) production in cooked rice, and then to find the effective combination of NaCl and commercial seasonings to inhibit the growth and SEA production without impairing the taste of cooked rice.

Methods: To examine the effect of NaCl, we used cooked rice to which 1-7% NaCl was added. The pHs of samples were adjusted to 4.0-5.5 with vinegars such as rice vinegar, balsamic vinegar, and apple vinegar. To screen for seasonings that are effective in inhibiting SEA production, 80 types of commercial seasonings were added to 1.5% NaCl-added rice, inoculated with SEA-producing strains and incubated at 37ºC. The concentrations of SEA were estimated by a western blot analysis using the enhanced chemiluminescence method. The detection limit of SEA in cooked rice was ca. 400 pg/g.

Results: The SEA production was not inhibited in cooked rice containing 0.8-1.5% NaCl, the range usually used to make rice balls, although the production was decreased in those containing 3-7% NaCl. Among about 80 seasonings added to cooked rice containing 1.5% NaCl, 15 seasonings showed inhibitory effect against the growth. The addition of rice vinegar, balsamic vinegar, mustard paste, and rose hip tea prevented the growth of the bacteria and the SEA production although they survived up to 12 h after incubation at 37ºC. The bacterial count was also reduced to below the detection limit ($< 10^1$ CFU/g) by the addition of Worcester sauce or mustard paste to vinegared rice (pH 4.5) after 48 h.

Conclusions: We proposed some preparation examples of rice ball containing these seasonings without impairing the taste.

Keyword: Staphylococcal enterotoxin A (SEA), Cooked rice, Rice ball, Sodium chloride (NaCl), Commercial seasonings

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-9)

The influence of information provision on the acceptance level of genome-edited foods among Japanese consumers

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Background and objectives: The genome-edited (GE) foods are allowed to be distributed in Japan after submission of the notification to the Ministry of Health, Labor and Welfare (MHLW). However, the acceptance levels of the GE foods among Japanese consumers are not high. This study aimed to investigate the acceptance levels of the consumers toward GE foods both before and after watching an original video explaining about GE foods.

Methods: A web-based survey was conducted in Japan from December 2021 to January 2022, where 3,408 consumers aged 20-69 participated. The contents of the original video consisted of 'difference between GE foods and genetically modified foods,' 'mechanism of GE technology,' 'necessity of GE foods,' 'benefit of GE foods,' and 'processes until GE foods are distributed.' The acceptance level of GE foods was investigated in terms of three perspectives: (1) distribution of GE foods in the market, (2) consumption of them by others, and (3) consumption of them by yourself. The scales were measured on a 7-point semantic differential (SD) scale form 1 (unacceptable) to 7 (acceptable).

Results: The levels of all three types of acceptance towards GE foods increased after watching the video compared to the ones before watching the video (distribution: 3.6 to 4.4, consumption by others: 3.7 to 4.4, consumption by yourself: 3.5 to 4.2, $p < 0.001$, respectively). The increase of the acceptance level of GE foods after watching the video was larger by those who understood video's contents, either fully or to some extent, than that by those who had difficulty understanding ($p < 0.001$, respectively). Multivariable linear regression analyses demonstrate that the level of understanding in two areas, namely 'necessity of GE foods' and 'processes until GE foods are distributed,' was an important factor to increase all three types of the acceptance towards GE foods

Conclusions: Our results suggest that adequate information provision can help increase the acceptance levels of GE foods among Japanese consumers.

Keyword: genome-edited foods

PAB(T8-10)

A Change-Point Regression approach for estimation of NOAEL from systematic review: Safety assessment of L-arginine

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Background and objectives: In recent years, many amino acids have been used as functional foods and dietary supplements. However, there are no guidelines concerning the upper limit of their dose for safe use. Generally, the safety of chemical compounds is assessed in vitro, in vivo test method and human overdose test. When these methods apply for safety evaluation of amino acids, it is not realistic because the acceptable daily intake (ADI) calculated based on the NOAEL obtained from the in vivo test is lower than the requirement value. Therefore, the data obtained from the human study is important for safety assessment of amino acids.Currently, systematic review (SR) has been interpreted as the method with the highest evidence level and it is also used for evaluation of effectiveness and usefulness of medicines or nutrition factors. We've reported the safety assessment by SR with the results of the human studies, using L-lysine, L-Ornithine and L- Citrulline as a model. However, these are provisional value and there are not enough number of researches to assess NOAEL. For the reason, we will try to estimate a new algorithm of NOAEL by safety assessment of L-arginine (L-Arg).

Methods: We performed a comprehensive search of databases for randomized controlled trial in which L-Arg with orally administered to healthy subjects. For evaluation of bias risk, Jadad Score and The Cochrane Collaboration's tool were used. The estimation of NOAEL was analyzed with Change point regression model, which modified by heterogeneity of study.

Results: The four hundred and forty-four articles were hit in database search and finally 31 articles were selected for review. NOAEL was estimated 4000 mg/man/time (12000mg/man/day) by observation data, and 9500-12418 mg/man/time by using CPRM.

Conclusions: We performed CPRM approach for determining NOAEL of L-Arg, and the NOAEL was estimated 9500-12418 mg/man/time. The new method will be able to apply in the variety of fields more than amino acids and dietary supplements.

Keyword: L-Arginine, Change-Point Regression Model, systematic review, NOAEL, safety

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-11)
Improving diet through agriculture and gender equality in South Sudan

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Background and objectives: Gender power dynamics and socio-cultural norms are significant drivers of equitable nutrition security within food systems. Protracted conflict and climate shocks, combined with outdated farming practices, have resulted in deteriorating food insecurity and diet quality in South Sudan. Discriminatory food consumption practices increase vulnerability for women/girls, including where men and boys eat first and best quality foods.

Methods: Fortifying Equality and Economic and Diversification (FEED) was implemented (2015-2018) in South Sudan by World Vision, Oxfam and CARE, with funding from Global Affairs Canada. It aimed to demonstrate how agriculture and women's empowerment affects nutrition in fragile contexts. FEED's activities focused on increasing agricultural productivity, income generating activities, and gender equality training. FEED created awareness on dietary diversification, food preparation, and hygiene through community dialogues and cooking demonstrations. Trained volunteers conducted home visits to promote optimal MIYCF practices. Women were supported to claim their productive assets and protection rights. Male allies/power holders were engaged to identify/address barriers that limited the decision-making power and resource control of women.

Results: Households that have year-round access to sufficient food to meet family needs increased from 21.3% to 31.4%. Children ate 2.53 meals/day on average compared to 1.6 at baseline. Households achieving minimum diet diversity increased from 31.3% to 71%; average number of food groups consumed increased from 2.96 to 5.14. There were significant behavioral/attitudinal changes towards gender equality, demonstrating impact on agency, resource control, and shifts in the informal/formal environment. Gender-Based Violence reduced from 33.1% to 27%, and the perception regarding ability of women to contribute to decision making improved from 54.5% to 79%. Engagement of women in income generating activities increased from 4.1% to 64.3%.

Conclusions: FEED is one of the first food security projects in South Sudan to adopt a gender-sensitive approach, specifically targeting female farmers and explicitly seeking to create behavioral/attitudinal changes towards more equal opportunities for women to claim their nutrition rights. The project demonstrated that improved nutrition is possible when women exercise agency over life decisions, have access and control over resources, and experience an environment around them as enabling opportunities to improve their nutrition.

Keyword: Agriculture, Gender Equality, Nutrition, Diet Diversity, Fragile context

Conflict of Interest Disclosure: None

PAB(T8-12)
Effect of mould fermentation on the nutritional and sensory attributes of different varieties of *Lablab purpureus* beans.

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Background and objectives: *Lablab purpureus* is a drought tolerant legume grown in semi-arid areas of Kenya. Though it contributes to nutrition and food security among the communities living in these areas, the legume has received low research attention due the perceived economic importance. The utilization of lablab is also influenced by the alleged taste and flatulence caused by their consumption. The main objective of this study was to evaluate the effect of mould fermentation with *Ragi IndoPal tempeh starter* on the protein content, protein digestibility, oligosaccharides and the sensory attributes of three varieties of fermented lablab beans grown in Kenya.

Methods: The beans of three lablab varieties namely KATDL1, KATDL2 and KATDL3 were cleaned, soaked, dehulled and cooked before inoculation with the tempeh starter culture at 35°C. After fermentation for 48 hours, determination of protein, protein digestibility, oligosaccharides as well as sensory evaluation of the fermented beans was carried out. Analysis of variance was carried out to detect significant differences at p =0.05 in the parameters of interest among the three bean varieties.

Results: The results showed a significant increase in protein content and invitro protein digestibility compared to unfermented cooked beans across the varieties. However, there was no significant difference among the varieties. The levels of oligosaccharides; stachyose and raffinose were significantly reduced at p=0.05. But there was also no significant difference in oligosaccharide content among varieties. But there was significant difference in preference and overall acceptability among the fermented beans due to variety, where KATDL1 was more acceptable than the other two varieties.

Conclusions: Fermentation increased protein content and digestibility, and decreased oligosaccharides, which cause flatulence in the Lablab beans. However, there was no significant difference among the fermented bean varieties in the protein content, protein digestibility and oligosaccharide content. There was also significant difference in taste and overall acceptability among the varieties.

Keyword: *Lablab purpureus* , Protein content, Oligosaccharides , Lablab varieties, Sensory evaluation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-13)

Bread-making quality and postprandial blood glucose response of gluten-free high-amylose rice bread

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Background and objectives: According to the World Health Organization, currently about 1% of the world's population suffers from celiac disease - a disease associated with a deficiency of enzymes that break down gluten and proteins close to it. Rice flour is completely hypoallergenic due to the absence of gluten and high-amylose rice is also suitable for people with diabetes. Given the increasing global incidence of gluten-related disorders and diabetes, the primary goal is to investigate the quality and postprandial glycemic response of gluten-free rice bread made with different amylose contents.

Methods: Two types of rice flour, intermediate-amylose Koshihikari rice flour (DK) and high-amylose Koshinokaori rice flour (KK), were used in this study. Gluten-free rice bread was made from rice flour, olive oil, sugar, salt, dry yeast and hydroxypropyl methylcellulose and baked at 180°C for 45 minutes. After baking the bread, the specific loaf volume, color parameters, and degree of gelatinization were measured. Physical properties (hardness, cohesiveness, adhesiveness) were measured using a TPU-2CL texture profile device (Yamaden Co., ltd). Glycemic response of rice bread was tested on eight healthy subjects (two males and six females) and compared with the equivalent carbohydrate dosage (50 g) of a control rice. The blood glucose levels were measured by self-measurement of blood glucose with finger pricking over time. Sensory evaluation was performed by 41 panelists on a 7-point scale.

Results: The specific loaf volume of KK bread was the same as that of DK bread. All indicators of color showed significant differences between DK and KK bread. When measuring physical properties, KK bread showed higher hardness and adhesiveness values, as well as lower cohesiveness, than DK bread. Fresh DK bread with better texture was preferred over KK bread. However, the sensory evaluation score of toasted KK bread was closer to that of DK bread. In eight healthy subjects, the glycemic response to KK bread was significantly lower than to DK bread.

Conclusions: These results show that amylose content affects bread quality and postprandial glycemic response to gluten-free rice bread.

Keyword: gluten-free rice bread, high-amylose rice, sensory evaluation, bread-making quality, physical properties

Conflict of Interest Disclosure: Yasuaki Enoki is an employee of Bourbon Corporation. The test rice flour used in the research was provided by Bourbon Corporation.

PAB(T8-14)

Physical, chemical and environmental characteristics of the acid buttermilk co-product: Case study in an eastern dairy in Algeria

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The dairy industry is one of the most sectors negative impacts on the ecosystems due to the increase of waste dairy by co-products. Buttermilk is an environmentally harmful co-product coming from the activities of butter workshop, because it has a high content of organic matter. It cannot be discarded directly into the environment. Dairy industries in Algeria are released over then more than 20.0000 liters of buttermilk into the sewer system without being confirmed or estimated for their components which may become an environmental risk and an economic problema.

The aim of this study is to evaluate and to present a characterization of sour buttermilk relating to an Algerian dairy industry. The results demonstrate that buttermilk has a high Biochemical Oxygen Demand (BOD) 312110±0.57 and a high Chemical Oxygen Demand (COD) (90351±0.002), Nitrite (NO_2-1.22 mg/l ±1; Nitrate (NO_{3-}) : 0,0299 mg/l ±0.0003; total azote (0.467 ±0.003), pH: (4.33±0.125), T : (15.66 C°±0.75).

Thus, buttermilk shows negative environmental impacts harmful mainly to human, animal and even aquatic life. For this, we must ring the alarm bell and take decisions to solve this ecosystem problem this solution could be summed up in its incorporation into certain food matrices given its richness in nutrients, particularly lactose and proteins The reuse of buttermilk is an objective of the sustainability of the Algerian dairy industries for an economic and environmental interest.

Keyword: Butter milk, co-product, Algerian dairy industry, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-15)
Changes of free amino acids and their effects on saltiness and palatability by the addition of spices in Japanese broths

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Background and objectives: We investigated the use of spices to reduce the amount of salt in diets. Previously, we have reported that some spices regulated the activity of glutamic acid decarboxylase (GAD67), which is expressed in type III taste buds, and affected the saltiness and palatability of food. However, the factors which may influence the effects of spices on food palatability remain unclear. In this study, we focused on free amino acids which exhibit various tastes, and investigated the relationship between the amount of free amino acids produced by spices and the saltiness and palatability of food. The study involved the use of Japanese broths, which are essential ingredients in Japanese cuisine.

Methods: Japanese broths (kombu, katsuo) were prepared in the traditional Japanese way, and each broth was mixed separately with 13 spice extracts at 0.02%.Free amino acids were analyzed using a Hitachi Ultra-High Speed Liquid Chromatography system equipped with UV-Vis detector. Sensory evaluation was based on the data obtained from the previous study.

Results: For the kombu broth, the total amounts of glutamic acid, proline, and alanine (umami and sweetness) increased in the presence of spices that control GAD67 activity. However, there was no correlation between the total amounts of histidine, cysteine, and arginine (bitterness), and GAD67 activity. For katsuo broth, there was no correlation between GAD67 activity and the total amount of umami, sweetness or bitterness Sensory evaluation data showed that saltiness of kombu broth decreased as the GAD67 activity increased. However, there was no correlation between saltiness of katsuo broth and GAD67 activity. In both, kombu and katsuo broths, palatability tended to increase as the GAD67 activity increased.

Conclusions: Addition of spices to either kombu or katsuo broth did not increase the saltiness itself but improved the overall palatability due to increased levels of free amino acids. Moreover, the results suggest that addition of spices may reduce the use of salt in food diets. Five out of the 13 spices (shiso, parsley, anise, yuzu, and basil) influenced free amino acid amounts in the broths. Therefore, these spices can potentially impact saltiness and palatability.

Keyword: spices, free amino acid, saltiness, palatability, GAD67 activity

Conflict of Interest Disclosure: The authors have no conflicts of interest, financial or otherwise, to disclose.

PAB(T8-16)
Potassium content of partially cooked vegetables

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Background and objectives: Most of the cut vegetables on the market are raw and intended for use in salads, but there are cut vegetables that have been parboiled to make stews. These partially cooked vegetables are intended for use in Japanese dishes such as pork in miso soup and stewed beef and potatoes. These products can be used to make dishes by simply adding seasonings or a few other ingredients. Thus, these products can be used to effectively increase vegetable intake for people with a low vegetable intake. Vegetables are a source of potassium. However, potassium is water-soluble, so potassium in partially cooked vegetables presumably decreases during the manufacturing process. The aim of the current study was to ascertain the potassium content in parboiled vegetables.

Methods: Six products used to make pork in miso soup, 6 used to make stewed chicken and root vegetables, and 5 used to make stewed beef and potatoes served as samples. The samples contained a liquid, such as a broth, packaged with the vegetables, so the vegetables and liquid were first separated. After diluting vegetables, the potassium content in the vegetable dilution and the liquid was measured.

Results: The minimum and maximum potassium content per 100 g of a sample was 2.9 mg and 112.4 mg for the pork in miso soup samples, 10.7 mg and 104.9 mg for the stewed chicken and root vegetable samples, and 50.5 mg and 228.3 mg for the stewed beef and potato samples. There were significant differences in the minimum and maximum potassium content among all 3 sets of samples ($p < 0.01$).

Conclusions:Differences in the potassium content in the samples was presumably due to differences in how ingredients were cut, pretreatment, and methods of manufacture. Some samples required draining of the liquid packaged with the vegetables while some did not. Samples that did not require draining tended to have a higher potassium content. From the perspective of potassium intake, selection of products that do not require draining will result in greater potassium intake.

Keyword: Partially cooked vegetables, Potassium content, Water-soluble

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-17)

Effects of sucrose and non-nutritive sweeteners on blood glucose and adiposity in obese mice

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Background and objectives: Non-nutritive sweeteners (NNS) are sweeteners that provide minimal or no calories, and have been widely used in different foods. This study was aimed at comparing the effects of sucrose and different NNS, both natural and synthetic, on adiposity and blood glucose in diet-induced obese (DIO) animals.

Methods: After being fed with a 60% high-fat diet (HFD) for 8 weeks, the C57BL/6 obese mice were administered with different sweeteners, including sucrose, natural monoammonium glycyrrhizinate (MAG) and monk fruit extract (MFE), as well as synthetic acesulfame potassium (ACE-K) and sucralose (SUC), in drinking water with below ADI doses and with equivalent sweetness. The animals were sacrificed after 8 wk intervention, and blood, liver, muscle, and adipose tissues were collected.

Results: The sucrose group gained more weight, which was reflected in the higher water consumption, whereas all NNS, regardless of natural or synthetic, did not show any effects on the body weight. Other than that, all sweeteners, including sucrose, showed no effects on the weights of gastrocnemius muscle and white adipose tissues, nor on observable pathological changes, including monocyte infiltration or fat accumulation, in the liver and epididymal adipose tissue. In addition, all sweeteners showed no effects on blood glucose and blood lipid profiles, except that the natural MFE significantly decreased the blood glucose levels, and synthetic ACE-K and sucralose significantly increased the glucose area under the curve (AUC) from the OGTT test when compared to the control group.

Conclusions: The results suggest that 8-wk administration of NNS did not show any adverse effects on body composition or blood lipid profiles in DIO mice. Sucrose consumption further increased the body weight, but MFE showed a hypoglycemic effect.

Keyword: Non-nutritive sweetener, Body weight, Blood glucose, adiposity

Conflict of Interest Disclosure: None

PAB(T8-18)

Availability of locally based complementary foods in Senegal: Nutritional and microbiological quality

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Background and objectives: Optimal complementary feeding practices are crucial in reducing stunting and essential micronutrient deficiencies in children aged 6-23 months. However, in Africa, mothers mostly have choice only between traditional porridges with little nutrient, and expensive imported flours. This study aimed at assessing the availability of local complementary foods in two regions of Senegal, and their nutritional and hygienic quality

Methods: This cross-sectional and descriptive study was performed during September-December 2019 in Dakar and Matam regions. An inventory of complementary foods was conducted in 47 World Food Program (WFP) retailers in Matam and 45 sales outlets in Dakar. Samples of local infant flours recovered from visited outlets were analyzed for macronutrients (proteins, lipids, carbohydrates) micronutrients (iron, zinc, calcium) content, and microbiological quality assessment (fecal coliform, salmonella, *Escherichia coli*, yeasts and molds). Compliance was evaluated according to Codex *Alimentarius* standards, WFP and GRET/IRD recommendations for complementary foods

Results: Complementary foods were more available in Dakar (86.7%) than in Matam (74.5%) and four types were listed, infant cereal flours being the most represented. All local complementary foods were infant flours (n=18) and were only found in 10.6% of WFP retailers in Matam and 35.6% of outlets in Dakar. All samples complied with Codex standard for energy value but only 16.7% and 27.8% met the GRET/IRD and WFP recommendations, respectively. For proteins content, 94.4% of the samples complied with Codex standard, 88.9% with the WFP recommendations and only 22.2% with the GRET/IRD recommendations. For lipids, 22.2% of the samples complied with Codex standard while 16.7% and 33.3% met the WFP and GRET/IRD recommendations, respectively. Less than half of the samples had a satisfactory micronutrient content while microbiological quality was satisfactory for *Escherichia coli* and Salmonella. However, fecal coliforms were present at levels above the threshold in 50% of the samples. Over 50% were moldy and yeasts were present in only 16.7% samples.

Conclusions: The availability of local complementary foods was lower than that of imported products in sales outlets, infant cereal flours being the most common products. Micronutrient contents and microbiological quality of these local product-based complementary foods need to be improved.

Keyword: local complementary foods, children 6 - 23 months, nutritional value, microbiological quality, standards

Conflict of Interest Disclosure: The authors declare that they have no conflict of interest.

PAB(T8-19)
Dinamics of phenols and antioxidant capacity changes in pulp, peel, and seed of avocado (*Persea americana* Mill. Var. Hass) during preharvest maturity.

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Background and objectives: World consumption of avocados (*Persea americana* Mill. Var. Hass) and its industrialized derivatives has increased rapidly, and the volume of wastes production. In the avocado fruit, the edible and inedible fraction contains diverse bioactive compounds, whose content depends on the maturation degree attained at harvest. The study's objective was to evaluate the content of phenolic compounds and antioxidant capacity of the pulp, peel, and seeds of avocado (*Persea americana* Var. Hass) according to the degree of pre-harvest maturation.

Methods: An experiment was established with 18 avocado trees (*Persea americana* Var. Hass) in a commercial orchard in Jalisco, Mexico. 345 fruits were marked to record monthly growth. From the beginning of maturation on the day after fruit set (DAFS) 283, fruits were collected on five dates to study the changes in the chemical and functional composition of the pulp, peel, and seed until DAFS 402 (n=4).

Results: The decrease in moisture content and the increase in dry matter in all collections were significant only in the seed, while the fat content in the pulp increased continuously up to 28% ($p < 0.05$). The content of total phenols (CTP) measured in pulp, seed, and peel (1.13±1.08, 32.43±12.18, and 101.39±33.49 mgEAG/Kg, respectively) remained stable throughout the pre-harvest maturation ($p < 0.05$). The tendency of the antioxidant capacity measured in the same structures by DPPH (10.73±2.11, 221.37±58.53, and 443.98±109.52, µmolET/Kg respectively) and ABTS (2.984±0.67, 33.137±6.34, 79.757±23.78, µmolET/Kg respectively) corresponded to the CTP (p&0.05); however, in the peel, a significant increase occurred from the DAFS 360. In analyzing the samples by HPLC of 13 compounds studied, traces of gallic, dihydroxybenzoic, syringic, and p-coumaric acids were found. Catechin, caffeic acid, and chlorogenic acid were in the seed (3.14±5.49, 0.903±1.31 and 0.304±0.19 ppp, respectively) and peel (14.17±10.32, 59.83±22.13 and 0.39±0.13 ppp, respectively) in quantifiable amounts. In the latter, chlorogenic acid and catechin steadily increased as maturation advanced ($p < 0.05$).

Conclusions: During pre-harvest maturation, the edible faction of the avocado does not show essential changes apart from the increase in fat content; however, the peel presents the highest content of total phenols with an increase in the content of chlorogenic and caffeic acid.

Keyword: Fat content, Growth curves, Chlorogenic acid, Food wastes

PAB(T8-20)
Determination of rancidity of frying oil by using spectrometer

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Background and objective: Deep–frying is a commonly cooking method for making crispy and delicious fried foods. Deep–frying oil should be changed in timely if it has an unusual color or odor, starts to smoke or starts to foam. The international oil quality standard is mostly based on total polar compounds (TPC) and the acid value (AV), a reliable benchmark for measuring the degradation of the oil. However, the traditional methods are time consuming with greater expense. The aim of this study was to examine the rancidity of frying oils by using near-infrared (NIR) spectroscopy.

Methods: We used 45 liters of soybean oil to fry 5 kg of chicken drumsticks each time. The temperature of the oil kept at 160±10℃ for 15±3 minutes until the chicken drumsticks were fully fried and the frying oil was repeated 40 times in total. The frying oils were collected each time and tested by oil quality test strips. Samples were scanned by NIR spectrometer and corresponded to the results by using the American Oil Chemists' Society (AOCS) official method Cd 20–91 and Cd 3d–63. The data from NIR spectrometer and the AOCS official method were calibrated by using partial leasts–quares regression (PLSR) method.

Results: We subjectively found that the oil color changed from clear to cloudy black, and the chicken drumsticks were also burnt brown during frying process. However, there was no significant differences in the oil quality tests strips. The TPC and AV of the frying oils were increased gradually. The PLSR models of TPC and AV showed good linearity. The TPC was in the range of 8~15±1%, and the AV was in the range of 0.09~0.8±0.08 mgKOH/g. The coefficients of determination for TPC and AV were as high as 0.972 and 0.969, respectively.

Conclusions: The results showed that NIR spectrometer can effectively measure frying oil quality and rancidity. Additional research is necessary to determine whether frying different

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

types of foods in an oil affects the reliability of the TPC and AV measurements.

Keyword: frying oil, total polar compounds, acid value, near-infrared spectroscopy

PAB(T8-21)
Construction of enterotoxinogenic *Escherichia coli* infection model using Caenorhabditis elegans as an alternative host

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Background and objectives: Enterotoxigenic *Escherichia coli* (ETEC) is a major cause of traveler's diarrhea in developed countries and infantile diarrhea in developing countries. *Caenorhabditis elegans* (*C. elegans*) has been used as an alternative model animal for studying pathogen interaction. ETEC was previously reported to shorten the survival time of *C. elegans* (Hoshino et al. 2008). However, the genetic background of the ETEC strain and host defense responses remain largely uncharacterized. This study aimed to uncover the molecular basis of host-ETEC interaction and establish a simple model system for ETEC infection using *C. elegans*.

Methods: The clinical strain ETEC1 (O6:H16), used by Hoshino et al. (2008), was also examined in this study. The draft genome sequence of the strain was assembled using short reads obtained by Illumina Miseq. Existence of enterotoxin genes were verified by tBLASTn and VirulenceFinder 2.0. Colonization factors (CSs) were also verified as same as the toxin genes. Wild-type *C. elegans* N2 was used as the experimental animal. The synchronized L1 larvae were grown on mNGM medium (agar medium for nematode growth) with non-pathogenic *E. coli* OP50, a standard food, until they reached adulthood. Thereafter, they were divided into groups fed OP50 or ETEC1 for lifespan assay. Survival rates were calculated by the Kaplan-Meier method, and differences in survival rates between the two groups were compared by the log-rank test

Results: Whole genome sequencing revealed that ETEC1 possessed heat-labile toxin LT1 and heat-stable toxin STh. Out of the major CSs, CS2 and CS3 exist on the ETEC1 genome. Worms fed ETEC1 showed significantly shorter survival time in comparison with those fed OP50, as shown in the previous study. We are currently validating differentially expressed genes (DEGs) using RNA-seq and real-time PCR to estimate host defense responses to ETEC1.

Conclusions:We established an *C. elegans* -ETEC infection model. It could be valuable for understanding the molecular basis on host-ETEC interaction and screens of functional food materials for anti-infective effects.

Keyword: enterotoxinogenic Escherichia coli, Caenorhabditis elegans, infection

Conflict of Interest Disclosure: This study was partially funded by Kyowa Hakko Bio Co., Ltd. Takashi Ishida is an employee of Kyowa Hakko Bio Co., Ltd.

PAB(T8-22)
Effect of heating method and formulation on the aroma profile of sponge cake

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Background and objectives: The microwave heating has the advantages of shorter cooking times and lower energy consumption compared to conventional oven. However, microwave heating products lack of color and aroma development, which leads to poor quality. There is few information on the effects of heating methods and formulation changes on the palatable quality including aroma profile of sponge cakes. This study aimed to examine the conditions of microwave heating to make sponge cakes with palatable quality by investigating the aroma profile of the sponge cake heated by an oven and a microwave.

Methods: The samples for analyses were the following four cakes: oven baked sponge cake containing 40% egg (OS); microwave-heated cake at the same ratio (MS); and microwave-heated cake containing 20.0% egg, 12.5% water and 7.5% vegetable oil (MB), oven baked cake at the same ratio (OB). In all samples, the contents of wheat flour and granulated sugar were fixed at 30%. The oven sample was baked at 170 ° C for 22 minutes and the microwave one was heated at 500 W for 100 seconds. The aroma compounds of each cake crumb were collected by HS-SPME and were analyzed using GC-MS and GC-O-MS.

Results: In each sample, alcohols, aldehydes, hydrocarbons and pyridines were commonly detected. Pyrazine was detected only in OS. The total peak area of sample by oven was larger than that by microwaves. GC-O analysis confirmed an almond-like, fragrant, and sweet odor in OS. Although egg-like odor was detected in MS and MB, these odor qualities were less than those in OS and OB. The final heating temperature of the cake crumb reached around 100 ° C with either heating method. However, long-time baking by oven promoted the lipid oxidation and the Maillard reaction, and caused richer aroma compounds, resulting in contribution to a production of complex flavor.

Conclusions: Since the complex flavor was not produced by microwave heating, the change of materials was thought to be required to improve flavor of cakes by microwave heating.

Keyword: Sponge cake, Microwave, Aroma compounds, SPME, GC-O

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-23)
Comparison of physiologically functional compounds in Sika deer *Cervus nippon* meats obtained from different regions of Japan

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Background and objectives: Recently, the overpopulation of wild deer causes the serious crop damage in Japan, and many deer has been caught in many regions to resolve this problem. Although the promotion of effective use of these deer as food resource have been conducted, the demands is not sufficient. Thus, we examined physiologically functional compounds to find characteristics of Sika deer meats obtained from different regions of Japan.

Methods: Three deer, each around 2 years old were obtained from Hokkaido, and Wakayama, Tokushima and Miyazaki prefectures, respectively. Muscle samples (*M. biceps femoris, M. psoas major, M. longissimus thoracis, M. pectoralis profundus*) were taken from these fresh carcasses. All samples were stored at -30℃ until analysis, and then thawed at 4℃ for 16h. Samples for analysis were prepared by homogenizing muscle with water and adding 5% TCA to remove proteins. The amounts of imidazole dipeptides (carnosine, anserine, balenine), free amino acids, and carnitine were measured with HPLC, amino acid analyzer, and LC/MS/MS, respectively.

Results: The amounts of carnosine and anserine in meats of Wakayama were significantly lower than those in meats of other regions, while the amounts of glutamine, ornithine, and 3-methylhistidine in meats of Wakayama were significantly higher than those of other regions. The amount of carnitine in meats of Hokkaido was significantly lowest in all regions, and the amount of acetylcarnitine in meats of Miyazaki was significantly highest in all regions. In muscle parts, the amounts of carnosine and anserine in *M. longissimus thoracis* has shown to be significantly higher than that in other parts. These differences in physiological compounds between the origin of Sika deer may have contributed to the branding of deer meats. Analyses of correlations among physiologically functional compounds in Sika deer meat showed negative correlation between imidazole dipeptides such as carnosine and anserine and glutamine and ornithine.

Conclusion:The characteristics of physiologically functional compounds in Sika deer meats may contribute to branding in the region of production.

Keyword: Deer meat, Physiologically functional compounds, Imidazole dipeptides, Carnitine, Acetylcarnitine

PAB(T8-24)
Study of the acidic compounds derived from triacylglycerol that contribute to acid value increment

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Background and objectives: The acid value (AV), which is widely used as an indicator of oil degradation, is defined as the titration value of free fatty acids (FFA) produced by hydrolysis of triacylglycerols. Although water is necessary for this hydrolysis, it has been reported that AV increases even when oil is heated without adding water. Hence, we hypothesized that acidic compounds other than FFA are formed from triacylglycerols (in particular, carboxylic acids that possess a glycerol backbone), and these carboxylic acids may be calculated as AV. In this study, we identified and quantified the acidic compounds formed in heated oil.

Methods: Pure canola oil was heated at 180°C for 6 h without adding water. The acidic compounds generated from the heated oil were derivatized with the 9-anthryldiazomethane reagent, which reacts selectively with carboxyl moieties. Derivatives were identified by ultra-high-performance liquid chromatography-time of flight mass spectrometry (UPLC-Tof/MS). Additionally, the acidic compounds formed during the oil heating process were quantified using gas chromatography-mass spectrometry. Finally, a deep-frying test of frozen French fries was conducted.

Results: When canola oil was heated without adding water, AV did indeed increase and was found to be significantly larger than the AV calculated from the amount of FFA measured by high-performance liquid chromatography-fluorescence detection. Then, we identified 9-carboxy-nonanoyl-triacylglycerols (i.e., dioleoyl-(9-carboxy-nonanoyl)-triacylglycerol and oleoyl-linoleoyl-(9-carboxy-nonanoyl)-triacylglycerol) as unique acidic compounds in the heated oil by UPLC-Tof/MS analysis. These compounds were considered to also be calculated as AV from the carboxylic moieties. We also confirmed this finding while cooking French fries; FFA and 9-carboxy-nonanoyl-triacylglycerols were increased, and the contribution of 9-carboxy-nonanoyl-triacylglycerols to AV increment was higher than FFA.

Conclusion:This study, for the first time, has successfully identificatied acidic compounds other than FFA which were formed during the heating of canola oil. These results suggested that AV not only is an indicator of triacylglycerol hydrolysis but also is an indicator of the thermal degradation of triacylglycerols.

Keyword: Acid value, carboxylic acid, edible oil, free fatty acid, triacylglycerol

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-25)

Positive association between a Food Production Diversity Score and the Minimum Dietary Diversity for Women of Reproductive Age (MDD-W) Indicator.

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Background and objectives: The Minimum Dietary Diversity for Women (MDD-W) indicator is used as proxy of prevalence of micronutrient adequacy in women of reproductive age. Information is needed on how MDD-W relates to agricultural indicators like households' farm production diversity, in order to inform agricultural nutrition sensitive programming. The objective of this study was to assess MDD-W and its association with a farm production diversity indicator in the rural area of Guerá region, Chad

Methods: We carried out a cross-sectional study in the region of Guerá (Chad). We randomly selected 984 women of reproductive age that were interviewed in March 2019. Sociodemographic data was obtained, as well as agriculture, food security, and dietary information through a 24 hours recall. We computed the MDD-W and the Household Food Insecurity Access Scale (HFIAS) scores using standard procedures. To evaluate food production diversity, we created a Food Production Diversity Score (FPDS) based on the following groups. For crops: “Grains and Tubers”, “Beans, peas and pulses”, “Nuts and seeds”, “Fruits” and “Vegetables”. For animals: “Cattle”, “Poultry” and “Goat and Sheep”. The FPDS was obtained summing all the groups. We assessed the bivariate association between MDD-W and FPDS and built a multivariable model to adjust this association by education and food security status.

Results: Only 32.8% of the women achieved MDD-W. The average FPDS was 2.9 with a standard deviation of 1.4 and 52.8% of the households reported severe food insecurity. A 48.5% of the sample had no education at all. The bivariate relationship between MDD-W and FPDS was found significant (p=0.001), with 45.4% MDDW reported in the 5-8 FPDS group, 32.8% in the 3-4 and 28.7% in the 0-2. In the multivariable model all associations remained significant. Women from households with 5-8 FPDS had 2.2 more chances to achieve MDD-W (IC95%: 1.5-3.3); as well as from educated households (OR 1.43; IC95%: 1.1-1.9). The likelihood of reaching MDD-W decreased a 9% with each point of the HFIAS (IC95%: 7%-12%).

Conclusions:In this context, policies and investments to increment households´ agriculture and livestock diversity might be useful to improve dietary diversity of women of reproductive age.

Keyword: dietary diversity, women, food production diversity, africa, Chad

PAB(T8-26)

The influence of heating temperature on the amount of proanthocyanidins and saponins in adzuki beans and adzuki bean tea

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Background: There are more polyphenols in adzuki beans than in black soybeans. We hypothesized that the antioxidant effects of polyphenols may prevent metabolic syndrome, and that saponin in adzuki beans may have diuretic effects. Polyphenols tend to be water soluble; thus, we developed a tea made with adzuki beans. We aimed to investigate the effect of heating temperature on proanthocyanidins and saponins in adzuki beans and adzuki tea.

Methods: We used the local Tanba Dainagon variety of the adzuki bean. We soaked the beans in water for one night, and then heated them. The heating temperatures were: 120°C, 150°C, 180°C, 210°C, and 240°C for 15 minutes. Acetone-water-acetic acid(70:29.5:0.5) solvent was used for extraction of proanthocyanidins and saponins. After its addition, the sample was shaken for 3 hours and then left standing for 12 hours followed by centrifugal-separation. Proanthocyanidin was measured using the 4-dimethylaminocinnamaldehyde method and saponin using the vanillin/sulfuric acid method. Catechin extraction was confirmed using high-performance liquid chromatography and a photodiode array.

Results: Proanthocyanidin quantity in an adzuki bean tended to be maintained by heating; however, at 240°C proanthocyanidin quantity decreased. The same trend was observed with adzuki bean tea. When the heating temperature became high, there was an increase of saponin, which was clear visible at 240°C. The same trend was observed with adzuki bean tea.

Discussion: The fragrance and taste of adzuki bean tea become stronger as the heating temperature increases; however, our findings suggest that it is necessary to consider the heating temperature as it may affect the effectiveness of the tea.

Keyword: adzuki bean, proanthocyanidin, saponin, heating temperature, polyphenol

Conflict of Interest Disclosure: Tanba Hikami Agricultural Cooperative Society

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-27)
Inulin enrichment in strawberry egg white pudding and its better physical properties using high pressure processing

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Background and objectives: Egg has been used as a main ingredient to make egg pudding dessert. However, the whole egg contains higher fat and calories than only egg white. Inulin is a functional fiber or prebiotic dietary fiber which can promote intestinal health. This study aims to develop a high protein and high dietary fiber pudding. It will be a good choice for people who are conscious of their health.

Methods: To produce and improve the physical properties of strawberry egg white pudding dessert, high pressure processing (HPP) which is a non-thermal process technology, is used in this study (450, 475MPa for 10 min) and compared with egg white pudding produced by traditional thermal processing (80°C for 30 min). The egg white solution was mixed with strawberry syrup and 5-15% inulin. The pudding's hardness, springiness, color, syneresis, and microstructure were measured.

Results: Strawberry egg white pudding with 10-15%inulin showed a lower hardness value than the pudding with 5%inulin. Using 450MPa caused 2times lower hardness value than using 475MPa and almost 10times lower hardness when compared to thermal processing ($p< 0.05$). The lightness values of the pudding decreased when increasing inulin content while redness and yellowness values increased. After storage at 4°C for 15days, higher inulin content in the HPP pudding leads to lower water syneresis. The addition of 15%inulin in pudding treated with 450MPa and 475MPa caused25.86%and 13.85%lower water syneresis when compared to that of 5%inulin ($p< 0.05$). However, pudding treated with thermal processing had 6times lower syneresis than HPP treated pudding. Microstructure of the surface of the pudding indicated that higher inulin content in the HPP pudding leads to show a smooth surface and more puffy texture.

Conclusions: In summary, our pudding showed a very smooth and very soft texture when compared to those that go through traditional processing. Inulin has a potential to improve the soft texture and creamy mouthfeel of the pudding and retain water within its structure. One serving of our strawberry egg white pudding contains 25 g. of inulin (15% w/w) which meets the recommended daily intake value.

Keyword: Inulin, functional food, high protein , egg white, high pressure processing

PAB(T8-28)
Qualitative and quantitative analysis of sphingomyelin from Atlantic salmon, *Salmo salar*

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Background and objectives: Sphingomyelin is the major phosphosphingolipid class of mammals and is generally known as a component of biological membrane. In recent years, sphingomyelin, especially from milk, has been reported to have several food functions such as improving skin barrier function and inhibiting lipid absorption. However, there is little information about food functions of sphingomyelin derived from marine sources, which has unique structures. In this study, we qualitatively and quantitatively analyzed sphingomyelin from Atlantic salmon to evaluate its potential as a new source of sphingomyelin.

Methods: Total lipids were extracted from lyophilized and powdered Atlantic salmon (*Salmo salar*) heads (n=3). After saponification of total lipids, sphingomyelin content was determined by HPLC equipped with an evaporative light scattering detector (ELSD). Sphingomyelin was purified by silica gel column chromatography, and the sphingoid base and fatty acid composition was determined by HPLC and GC, respectively, after hydrolysis and derivatization. In addition, intact molecules of sphingomyelin in Atlantic salmon were identified by LC-MS/MS analysis

Results: The content of sphingomyelin in the salmon heads used in this study was 1.6±0.2 mg/g dry weight (172.0±8.7 mg/head). Comparing the content of each tissue, sphingomyelin was relatively abundant in the eyes. Major constituent of sphingoid bases was d18:1 with d18:0, d18:2, and d19:1 also present.C14:0, C16:0, C18:0, and C22:1 were detected as constituent fatty acids. In LC-MS/MS analysis, 23 molecular species of sphingomyelin were identified. The sphingomyelin molecules in Atlantic salmon are highly unsaturated relative to those in milk and eggs.

Conclusions: Our results shows that Atlantic salmon head is a promising source of sphingomyelin ingredients. Sphingomyelin of Atlantic salmon attracts attention for its food functionality because of its unique chemical structure, which is different from those of milk and eggs.

Keyword: Sphingomyelin, Atlantic salmon, Mass spectrometry

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-29)
Development of branched-chain amino acid rich pudding for the elderly using silkworm pupae

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Background and objectives: Elderly tend to have insufficient protein intake due to their impaired chewing and swallowing abilities and gastrointestinal functions. About 10-27% of the older population worldwide is suffering from sarcopenia. Adequate daily intake of essential amino acids (EAAs), particularly branched-chain amino acids (BCAAs), can reduce the risk of sarcopenia by preserving the muscle mass. Edible insects are considered as a sustainable alternative source of high-quality protein. This study aimed to develop a pudding having suitable texture and adequate amounts of EAAs and BCAAs for the elderly by using silkworm pupae as major protein source.

Methods: Linear programming was performed to obtain the recipes containing silkworm pupae and other protein-rich ingredients, in which one serving provided ≦200 kcal energy, 10 g protein, ≧0.9 g EAAs, and ≧0.7 g BCAAs. Various amounts of gelling agents, including gelatin, agar, and xanthan gum, or their 2:2:1 mixture were used for modifying the textural properties of pudding. Sensory acceptability was evaluated by elderly panel. Nutritive value including amino acid composition of the product were analyzed. Protein digestibility was determined by *in vitro* gastrointestinal digestion. Protein quality was determined as Predicted Digestibility-Corrected Amino Acid Score (PDCAAS).

Results: The formulated pudding contained 15% silkworm pupae, 15% coconut milk, 8% Job's tears, 4% sunflower seed, 3% sugar, and 0.4% salt. Texture of the pudding became harder and less cohesive with more gelling agent, especially agar. The pudding with 1% (w/w) gelling agent mixture had the most suitable textural properties with hardness 1568 N/m^2, adhesiveness 824 g·s and cohesiveness 0.41. Such values met the criteria of Universal Design Foods Level 4, and IDDSI Level 4, suggesting that the pudding is puree-like and does not need chewing. The product was accepted by healthy elderly in all sensory attributes and portion size and was rated as easy to chew and swallow. One serving (120 g) of the developed pudding provided 182 kcal, 12 g protein, 3.2 g EAAs, and 1.7 g BCAAs, which was considered “high protein”. The protein digestibility and PDCAAS were 71.21% and 0.21, respectively.

Conclusions: Silkworm pupae could be a potential protein source for developing high-protein BCAA-rich food for the elderly.

Keyword: Branched-chain amino acids, Elderly, Pudding, Silkworm pupae, Texture modification

PAB(T8-30)
Physical properties of cooked rice grown by organic cultivation under various storage conditions

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Background and objectives: The quality of polished rice as the raw material for cooked rice is influenced by various factors, such as the variety, production area, cultivation method, and storage environment.

Methods: This study compared the quality of ‘Kinu Musume' rice organically cultivated in Shimane Prefecture, cooked, and stored under various conditions. Polished ‘Kinu Musume' rice was washed, soaked, and cooked, and its physical properties, appearance (shape), and moisture content were measured after storage under each condition.

Results: On comparing the physical properties of the cooked rice immediately after cooking (Condition 1) and after 8 hours of storage in a warmer environment (Condition 2), the rice was significantly harder, with greater surface adhesion and elasticity, and it showed a lower (stickiness-hardness) balance value, which is an index for palatability evaluation, under Condition 2. As for its appearance properties, it showed significantly lower values for grain length and grain thickness under Condition 2. On comparing the physical properties of the cooked rice under Condition 1 and after 1 week (Condition 3)/1 month (Condition 4) of frozen storage at -30°C and reheating, the rice was significantly harder, with lower stickiness, poorer stickiness-hardness balance, and significantly higher adherence, cohesiveness, and elasticity under Conditions 3 and 4. As for its appearance properties, it showed significantly lower values for grain length, grain width, grain thickness, and weight under Conditions 3 and 4.

Conclusions: Based on the results, the physical and appearance properties of cooked rice grown by organic cultivation may vary according to the storage condition.

Keyword: cooked rice, organic cultivation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-31)
Effect of trehalose on the quality of gluten-free rice bread made from two types of rice flour with different amylose contents

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Background and objectives: Gluten ingestion has been linked to several clinical disorders includes celiac disease, wheat allergy, and non-celiac gluten sensitivity. Celiac disease is still rare in Japan; however, wheat allergy occupied 11.7% of food allergies next to egg and milk. Nowadays, the rising incidence of gluten-related disorders, promotes worldwide interest in various gluten-free products. Rice flour is completely hypoallergenic due to the absence of gluten. We reported the preparation of gluten-free rice bread without major food allergens—egg, milk, and wheat flour—achieving success by using 0.8% Hydroxypropyl methylcellulose (HPMC). However, when baking rice bread without gluten, it is easy to retrogradation. The objective of this study was to evaluate the effect of trehalose, disaccharide of glucose, on the quality of gluten-free rice bread made from two types of rice flour with different amylose contents.

Methods: Two types of rice flour, intermediate-amylose Koshihikari rice flour (DK) and high-amylose Koshinokaori rice flour (KK), were used in this study. Gluten-free rice bread was made from rice flour, olive oil, sugar/trehalose, salt, dry yeast and HPMC, and baked at 180 ° C for 45 minutes. After baking the bread, the specific loaf volume, color parameters (L*, a*, b*), water content, and degree of gelatinization were measured. Physical properties (hardness, cohesiveness, adhesiveness) of rice bread were measured using a TPU-2CL texture profile device (Yamaden Co., ltd). Sensory evaluation was performed on a 7-point scale.

Results: DK, DK with trehalose (DKT), and KK breads showed the same specific loaf volume, which were higher than KK bread with trehalose (KKT). The degree of gelatinization of DK and DKT breads were significantly higher than KK and KKT breads. When measuring physical properties, KK and KKT breads showed higher hardness value, as well as lower cohesiveness, than DK and DKT breads. The sensory evaluation score of chewiness and moistness in rice bread with trehalose showed higher than that of rice bread without trehalose.

Conclusions:These results show that amylose content and trehalose affects bread quality to gluten-free rice bread.

Keyword: gluten-free rice bread, trehalose, bread-making quality, physical properties, sensory evaluation

Conflict of Interest Disclosure: Rice flower of Koshinokaori were provided by Bourbon Corporation

PAB(T8-32)
Higher amounts of proximates and minerals in locally formulated biscuit using African locust beans

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Background and objectives: Food insecurity is still endemic in most parts of sub-Saharan Africa. According to the World Bank, severe food insecurity in Ghana in 2019 was 8%. The majority of this population lives in the northern sector. This study was a quasi-experimental designed study carried out in the Wa Municipality to determine the proximates and nutrients in African locust beans (*Parkia biglobosa*). We also assessed the acceptability of biscuits manufactured from the proportions of fruit powder mixed with wheat flour.

Methods: Proximate analysis was carried out on prepared samples for the following parameters; protein, calcium, carbohydrate, crude fiber, fats and ash. Sensory analysis was performed to assess the acceptability of the products. We used a completely randomized design with two treatments: wheat flour (WF) and African locust beans fruit pulp flour at 100, 75, 25, and 0%. A total of 100 respondents were randomly selected to test the biscuits' appearance, taste, texture, scent, and general acceptability, using a 9-point hedonic scale questionnaire. Results: The age of the panellists ranged from 18 to 52years. The proximate composition of the locust beans flour was dietary protein (12%), fibre (6.2%), dry matter (92.59%) and ash (1.9%). The quantities were higher in locust pulp flour compared to the control (wheat flour) sample except for fat and oil. Minerals such as phosphorus (1678 µg/g), calcium (0.975 µg/g) and sodium (974.6 µg/g) were high in locust pulp flour compared to the control sample. Similarly, composite biscuits had higher nutrient composition compared to the control sample. Protein, fibre, carbohydrate were statistically significantly ($p < 0.001$) higher for sample 25/75 compared to the control and 50/50 and 75/25. Phosphorus, calcium, sodium, and magnesium content increased with increased locust pulp flour, with sample 25/75 recorded the highest mineral content. Conclusions: Proximate composition of locally produced biscuit is higher than wheat flour and also rich in essential minerals

Keyword: African locust bean, proximate analysis., nutrient composition, Biscuit

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-33)
Effect of different processing methods on the allergenic protein (tropomyosin) of house cricket

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Background and objectives: House cricket (*Acheta domesticus*) is a sustainable source of protein and micronutrients, and has been approved as a novel food by European Union. However, allergenicity is the potential risk of edible insects including house cricket. The previous studies indicated that sensitized individuals with crustacean allergy may be allergic to insects. Tropomyosin has been identified as one of allergenic proteins in edible insects. The various food processing methods including frying, baking and steaming are commonly applied to edible insects. Therefore, the objective of the study is to investigate the thermal stability of house cricket tropomyosin.

Methods: The house crickets were processed by different food processing methods including baking, frying and steaming with different temperatures. The crude proteins of processed samples were extracted and analyzed by gel electrophoresis and immunoblot.

Results: The results of gel electrophoresis and immunoblot indicate that tropomyosin is the most abundant thermally stable protein in the protein extracts of processed house cricket. The immunoblot results show that tropomyosin keeps its immunoreactivity and integrity in the samples with different processing treatments.

Conclusions: House cricket tropomyosin is the dominant allergenic protein that is resistant to common food processing methods.

Keyword: Food allergy, Edible insect, Tropomyosin

PAB(T8-34)
NIRS Prediction Modelling for Simultaneous Multi-trait Assessment in Diverse Cowpea *Vigna unguiculata* (L) Walp) Germplasm

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Background and objectives: Cowpea is one such legume which can facilitate to achieve goals on sustainable nutrition and climate change. Assessing nutritional traits conventionally can be laborious and time consuming. NIRS (Near Infra-Red Reflectance Spectroscopy) is a technique use for rapid determination of biochemical parameters for large germplasm.

Methods: NIRS prediction models were developed to assess protein, starch, TDF (Total dietary fibre), phenols and phytic acid based on MPLS regression. Paired t-test was used to determine the difference in the mean of analytical and predicted values.

Results: Higher $RSQ_{external}$ (coefficient of determination) values were obtained for different traits protein (0.882), starch (0.996), TDF (0.901), phenols (0.704) & phytic acid (0.955) in "2,4,6,1", "2,8,8,1", "2,4,4,1", "3,4,4,1" and "2,8,8,1" mathematical treatments respectively. Models for protein, starch, TDF and phytic acid displayed RPD (residual prediction deviation) values of &3 except phenolics (1.81) and low SEP (standard error of performance) indicating the excellent prediction of models. For all the traits worked, p value more than 0.05 implying the model's accuracy and reliability.

Conclusions: The developed models will facilitate high throughput screening of large cowpea germplasm present in the national gene bank at ICAR-NBPGR, New Delhi for identification of traits specific germplasm and selection of desirable chemotypes in any genetic background with huge application in cowpea crop improvement programme across the world.

Keyword: MPLS regression, Nutritional composition, Variability, RPD (residual prediction deviation), RSQexternal (coefficient of determination)

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-35)
Mining Nutri-dense Accessions from Assam Collections of Rice

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Background and objectives: Rice is a staple crop for more than half of the population where North-East Indian states are primarily dependent on rice for their diets. Traditional rice germplasm or landraces are a good source of diverse phenotypic traits. The indigenous people of Assam conserve and grow various landraces which are highly diverse but still remain nutritionally uncharacterized.

Methods: Nutritional profiling of 395 landraces from Assam was done for total protein content (PC), starch, amylose content (AC), total dietary fibre (TDF), oil, phenol and phytic acid (PA) using AOAC and standard methods. Multivariate statistical analysis including principle component analysis (PCA) and hierarchical cluster analysis (HCA) was applied to decipher the similarities/differences in the multiple nutritional attributes.

Results: The mean total PC, starch, AC, TDF, oil, phenol and PA content of the landraces was 9.8%, 75.2%, 22.3%, 4.7%, 5.3%, 0.4% and 0.34% respectively. Compositional diversity existed between the accessions where landraces contained comparatively higher PC, oil and TDF than commercial rice varieties. PCA revealed that first four principle components i.e. PC1, PC2, PC3 and PC4 contributed to 81.6% of variance where maximum loadings were from protein, oil, starch and phytic acid. HCA revealed 16 clusters where major findings were Cluster I containing high PC (max. 11.7%) and moderate AC (22%), cluster II containing very low AC (min. 6%), cluster IV containing high oil (7%), TDF (5%), low starch (69%) and moderate AC (21%). Cluster XI which contained high AC (27%) and PA (0.5%). Cluster IX containing low phenols (0.2%) and PA (0.3%).

Conclusions: Based on the nutritional profiling and multivariate analysis, land races can be targeted to meet specific nutritional needs. Such as the one with high amylose, low starch and high protein for low glycemic value while low amylose with high protein for baby foods. Accessions with moderate AC could be utilized for their good cooking quality while those with high oil content could be extracted for high value rice bran oil. Landraces with low phenol and phytic acid could be consumed for increased bioavailability of minerals.

Keyword: Landraces, Nutrients, Variability, Multivariate, Analysis

PAB(T8-36)
Dietary Alaska pollack protein increases skeletal muscle weight and decreases gene expression of negative regulators of skeletal muscle mass in rats

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Background and objectives: Our previous studies demonstrated that dietary Alaska pollack protein (APP), as the sole protein source, increased gastrocnemius skeletal muscle weight after only 2 days of feeding, and this hypertrophic effect was maintained for over 56 days of APP intake. However, the mechanisms responsible for this effect are unclear. Anabolic growth is achieved when muscle protein synthesis exceeds degradation. Balance between protein synthesis and degradation is controlled by multiple signaling pathways. In this study, we examined the effects of dietary APP on muscle protein content and gene expression of important regulators of skeletal muscle mass.

Methods: Male 5-week-old Sprague-Dawley rats were divided into six groups and fed AIN-93G diets with casein or APP, containing the same amount of crude protein, for 1, 2 and 7 d (n= 10/group).

Results: The gastrocnemius muscle weight of the APP group was significantly higher than that of the casein group after 1, 2 and 7 d of feeding. The gastrocnemius muscle protein content of the APP group was significantly higher than that of the casein group after 7 d of feeding, but not after 1 and 2 d of feeding. The gene expression of Mstn /Myostatin of the APP group was significantly lower than that of the casein group after 2 and 7 d of feeding, but not after 1 d of feeding. The gene expression of Trim63/MuRF1 and Fbxo32/atrogin-1 of the APP group were significantly lower than those of the casein group, regardless of the duration of APP intake. On the other hand, dietary APP did not alter Igf1 gene expressions, regardless of the duration of APP intake.

Conclusions: We demonstrated that dietary APP induces rapid increases in the gastrocnemius muscle weight and decreases in the gene expression of negative regulators of skeletal muscle mass, such as Mstn, Trim63 and Fbxo32. Dietary APP may induce skeletal muscle hypertrophy by promoting positive protein balance.

Keyword: 1. Ehime University (Japan), 2. Nippon Suisan Kaisha Ltd. (Japan), 3. Utsunomiya University (Japan), 4. Yokohama University of Pharmacy (Japan), 5. The University of Tokyo (Japan)

Conflict of Interest Disclosure: This research was funded by Japanese Council for Science, Technology and Innovation (CSTI), Cross-ministerial Strategic Innovation Promotion Program grant number14533567 (to S.O. and T.K.) and Nippon Suisan Kaisha, Ltd. (to M.F. and T.K.). K.U. is a current employee of Nippon Suisan Kaisha Ltd., and K.H. is a former employee of Nippon

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Suisan Kaisha Ltd. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

PAB(T8-37)
Assessment of zinc content in parboiled rice from popular varieties grown in Bangladesh

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Background and objectives: Rice is the main source of zinc for Bangladeshi population. Rice is consumed as parboiled rice in Bangladesh, however, the zinc content in rice is low after parboiling and milling. Rice millers tend to over-polish rice to improve its appearance and sell the rice as *Minikit* variety or type. Since over-polished rice contains lower zinc concentration, it is necessary to determine the zinc content of rice identified as *Minikit* and determine how different is to other popular varieties found in markets.

Methods: Rice samples (240) were collected from markets of 5 districts (Barisal, Bogura, Faridpur, Jamalpur and Rangpur), in each district samples were obtained from 2 urban and 2 peri-urban markets. Also, 24 rice samples were collected from households in rural villages in each of the 5 districts. The zinc content was measured in all samples. Zinc content was measured using a non-destructive energy-dispersive x-ray fluorescence spectrometry (XRF). Apparent milling degree and grain shape was also determined.

Results: Rice from urban and peri-urban areas had 8.1-8.3 µg/g which was lower than rice from households in rural areas (9.9 µg/g). The rice varieties with the lowest zinc concentration were *Minikit* (6.3 µg/g) and *Guti Swarna* (6.3 µg/g), which were 21–52% lower than 9 of the most common varieties found. The highest zinc concentration was found in rice variety *Ranjit* (13.2 µg/g). There was a significant difference in zinc content by district which could be due to the variety but also the severity of milling preferred in such districts.

Conclusions: *Minikit* rice had lower zinc content than the most popular varieties. Given the high zinc deficiency in Bangladesh and the evidence generated, it is necessary to create policies to discourage the over-processing of rice and create awareness of the poor nutritional content of *Minikit* rice compared to other varieties, especially in urban and peri-urban markets.

Keyword: Rice milling, Zinc content, Minikit, Parboiling

PAB(T8-38)
Effect of refrigerated storage on major crustacean allergen tropomyosin

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Background and objectives: Crustaceans including shrimp, crab and lobster are popular seafood with health benefits. However, crustacean is also one of major food allergens. Tropomyosin has been identified as the major allergenic protein among edible crustacean species. Tropomyosin is a myofibrillar protein that is able to resist common food processing. Proteins in foods are affected and degraded by processing and storage conditions. Refrigeration is an important and common method used by industrials and consumers for preserving crustaceans. Therefore, the objective of the study is to examine the effect of refrigerated storage on crustacean tropomyosin.

Methods: The raw muscle samples of white shrimp (*Litopenaeus setiferus*), mud crab Scylla serrata) and American lobster (*Homarus americanus*) were refrigerated at 4°C up to 7 days. The proteins of samples were extracted by phosphate buffered saline. The protein extracts were analyzed by gel electrophoresis and immunoassay using anti-tropomyosin antibody.

Results: The results of gel electrophoresis showed that the protein profiles during the period of refrigerated storage were similar within each of species (white shrimp, mud crab and American lobster). The results of immunoassay revealed that the tropomyosin of three crustacean species tested kept the immunoreactivity and was not affected by refrigerated storage up to 7 days.

Conclusions: Generally, the shelf life of raw crustaceans at 4 °C is 2-4 days. The potential autolysis and microbiological growth in the raw crustaceans usually cause protein degradation. In the present study, the refrigerated storage does not affect the integrity and immunoreactivity of crustacean tropomyosin while the crustaceans are still fresh for consumption.

Keyword: Food allergy, Crustacean, Tropomyosin

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-39)
Color reaction of Tutankhamen's pea upon heating

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Background and objectives: Immature Tutankhamen's pea, an ancient pea variety (*Pisum sativum* L.), has the unique characteristic of changing from green to reddish brown when heated. In this study, the mechanism underlying this color change was investigated by identifying the color source and pigment.

Methods: Water extracts of whole pea, seed coat, and pea endosperm were heated at 100 ℃ for 20 min to locate the color source. A water extract of the seed coat was treated with a Sep-Pak C18 cartridge and subjected to high-performance liquid chromatography using HILIC columns to isolate the color source. To clarify the detailed structure of the coloring source, a butanol-hydrochloric acid reaction, thiol decomposition, and acid hydrolysis were performed; the product was subjected to liquid chromatography–tandem mass spectrometry (LC-MS/MS) using an Atlantis T3 column. Pigment component generated by heating at 100 ℃ for 4 h the isolated color source was analyzed by LC-MS/MS. These compounds were characterized based on their unique fragmentation patterns in negative ion mode.

Results:The color source was located in the seed coat. LC-MS analysis of the compound provided signals at m/z 609.1 and 611.0 in the negative and positive ion modes, respectively. This indicates that the mass of the color source is 610. MS/MS analysis showed that the compound is a B-type prodelphinidin, and is a dimer of (–)-epigallocatechin (EGC) formed by a cleavage reaction between various flavans. Heating the isolated (–)-EGC dimer resulted in the production of a pigment component. LC-MS peak was detected at m/z 607.0 and 608.9 in negative and positive modes, respectively. The molecular weight of the pigment component in this case was estimated to be 608. This is consistent with the weight of an oxidized (–)-EGC dimer, which was identified as the color source.

Conclusions: The color source of Tutankhamen's pea upon heating was determined to be a dimer of (–)-EGC, and it was found to be located in the seed coat. This study revealed that the color reaction of Tutankhamen's pea upon heating is caused by the oxidation of the (–)-EGC dimer.

Keyword: Tutankhamen's pea, Color reaction, Cleavage reaction, (–)-Epigallocatechin dimer, Oxidation

PAB(T8-41)
Biofortification in Wheat: Research Progress, Potential Impact, and Policy Imperatives

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Background and objectives: Biofortification is a promising strategy to reduce the persisting micronutrient deficiency. Biofortifying wheat grains has the potential to alleviate malnutrition as it is one of the major consumed staple crops. In the milieu, an attempt has been made in this study to examine the research progress, and impact of agronomic and genetic efforts on wheat biofortification.

Methods: Data has been sourced from the Scopus database using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach. The compiled data were subjected to meta-analysis and bibliometric coupling (using the VosViewer visualization tool) to assess the impact and research progress of biofortification, respectively. In addition, the economic surplus model was used to capture the impact of adopting a biofortified wheat variety.

Results: Bibliometric analysis indicated that developing countries like India, Pakistan, and China lead the research in wheat biofortification, followed by Turkey, Australia, the United Kingdom, and the United States of America. Using meta-analysis we find that agronomic biofortification leads to a 1.6 standard deviation (SD) and 1.7 SD increase in zinc (Zn) and iron (Fe) concentration, respectively. Genetic biofortification efforts lead to a 74% and 79% increase in Zn and Fe contents, respectively. India's first biofortified wheat variety (WB 02), since its release, is cultivated in around 144,256 hectares generating an estimated economic surplus of INR 50.54 million at the constant price (base year as 2011-12).

Conclusions: The effects of biofortification were larger in Asia and Africa, where micronutrient deficiency and hidden hunger are widespread. In India, genetic biofortification has more potential than agronomic biofortification as the impact of the former on wheat micronutrient concentration was around three times higher than the latter. Further, genetic biofortification has been recognized as an economical and sustainable strategy. We propose policy inputs to strengthen the value chain on biofortification, followed by a framework to upscale the adoption of biofortified wheat varieties to combat hunger and improve its effect on nutritional outcomes.

Keyword: Biofortification, Meta-analysis, WB 02, Bibliometric analysis, Biofortified wheat

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-42)

Identification of transdermal sensitizing allergens in edible cricket protein and verification of cross-reactivity.

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Background and objectives: Edible insects are attracting attention as a new protein food resource to address the food crisis. However, there have been few studies on their safety and allergenicity. In addition, it has recently been shown that food allergy involves transdermal sensitization. Therefore, in this study, we examined whether edible cricket protein has the ability to sensitize transdermally using a mouse model system, and detected and identified transdermal sensitizing antigens and examined their cross-reactivity to other foods.

Methods: Powdered edible Acheta domesticus products were obtained and samples of the supernatant (protein concentration 5 mg/ml), which was agitated and extracted in 5% SDS solution, were applied to the backs of female Balb/c mice (n=6) at 25 µl four times a week for 5 weeks, while only 5% SDS was applied in the control group. During the application period, blood samples were collected and hair was shaved once a week under anesthesia. After blood collection, antigen-specific IgE and IgG1 antibody titers were measured by ELISA. Then, using the IgE and IgG1 binding activity evaluated by immunoblotting and ELISA as an indicator, purification and identification of candidate allergen molecules in cricket protein were attempted by ion exchange column chromatography and gel filtration HPLC. Cross-reactivity was evaluated by immunoblotting and ELISA using edible parts of shrimp, crab, clam, tuna, pig, and chicken as well as crickets.

Results: In the control group, there was no increase in antibody titer of both cricket-specific IgG1 and IgE. In the cricket group, antibody titers of cricket-specific IgE and IgG1 increased significantly at 5w compared to 0w. Immunoblotting analysis showed a distinct IgG1 binding protein band around 37 kDa. After purification and in-gel digestion, MS analysis showed that this molecule is tropomyosin, a pan-allergen of arthropods. The results also suggest that this molecule might be cross-reactive with tropomyosin in other species of edible crickets, shrimp, and crab.

Conclusion: This evaluation system suggests that edible cricket proteins can sensitize percutaneously, and the arthropod pan-allergen, tropomyosin was identified as one of the major percutaneous sensitizing antigens. Furthermore, tropomyosin from edible crickets was suggested to be cross-reactive among arthropods.

Keyword: edible insects, cricket, transdermal sensitization, allergens, tropomyosin

PAB(T8-43)

A novel culture medium for cultured meat production using microalgae-derived nutrients and mammalian cell-secreted growth factors: Development of serum-free and grain-derived nutrient-free medium

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Background and objectives: Today, due to global population growth and increasing demand for meat products, shortage of food protein is a growing concern. Cultured meat production has been proposed as one of the solutions, and this technology has attracted worldwide attention for its potential to solve the global resource and energy consumption and animal welfare issues associated with conventional meat production. Cultured meat is produced by proliferating animal myoblasts using cell culture technology. To take this process from the lab bench to the industrial scale would require significant amounts of culture medium. The culture medium is composed of nutrients derived from grains and heterotrophic microorganisms and fetal bovine serum (FBS), which will impact the sustainability of cultured meat in future owing to high food prices, increased environmental impact from fertilizer and pesticide use, and ultimately livestock use. Compared to grains, microalgae have higher growth capacity and lower carbon footprint, making them a cost-effective and eco-friendly material. Several studies have claimed that cell culture supernatants containing growth factors, promote animal cell proliferation and have potential as an alternative to FBS. Here, we developed a novel medium containing nutrients extracted from microalga and cell-secreted growth factors without grain-derived nutrients and animal sera.

Methods: First, *Chlorella vulgaris* -derived nutrient medium (CVNM) was prepared by adding *Chlorella vulgaris* extract (CVE) to the inorganic salt solution that served as the basis for the culture medium. The mammalian immortalized cell line (provider cells; named after they 'provide' growth factors) were cultured in CVNM and the supernatant was obtained as the conditioned medium (CM). This CM, with CVE added as a nutrient source, was applied to primary bovine myoblast cultures.

Results: The provider cells were successfully allowed to survive in CVNM, and this CM promoted the proliferation of bovine myoblasts.

Conclusions: Bovine myoblasts, the main cell source for cultured meat, were found to be able to proliferate only with nutrients derived from microalgae and growth factors secreted by the provider cells. This study will contribute to improving sustainability of cultured meat as well as other industrial product based on cellular agriculture.

Keyword: Cultured meat, Microalgae, Conditioned medium, Growth factor, Bovine myoblast

Conflict of Interest Disclosure: Tokyo Women's Medical University received research funds from IntegriCulture, Inc. I. Kawashima is chief technology officer of IntegriCulture, Inc.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-44)
Livestock Programming for Nutritional Improvements in Children Under 5 Years _ Marsabit County; Kenya

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Background and objectives: The Food and Agriculture Organization of the United Nations in collaboration with UNICEF and Washington State University implemented a research project from August 2018 to September 2022, to assess the impact of livestock programming on nutrition improvement of children under five years and pregnant and lactating women, in Marsabit County, Kenya. The objectives of the USAID funded project were; to determine the effect of providing livestock feeds during critical dry periods on household milk yield; to determine the effect of providing livestock feeds and nutritional counselling on milk consumption by children under five years and pregnant and lactating women; and to determine the effect of providing livestock feeds and nutritional counselling on risk of acute malnutrition among children under five years and pregnant and lactating women.

Methods: A cluster randomized control trial study design was applied. The study targeted households with children under five years and pregnant and lactating women, divided into two intervention arms and one control arm. Intervention arm one consisted of 600 households receiving livestock feeds only during dry seasons; Intervention Arm two consisted of 600 households receiving livestock feeds and weekly nutritional counselling during dry seasons; Control arm consisted of 600 households receiving none of the two interventions but accessing routine human and animal health care. Anthropometric measurements of children and pregnant and lactating women, milk yield, food consumption data and human and animal health data were collected every 6 weeks. Household socio-economic data and demographics were collected every quarter.

Results: Households receiving livestock feeds produced 0.63 more litres per days, compared to households in the control arm; Children in arm receiving livestock feeds and nutritional counselling consumed an average of 240 ml more milk per day compared to those in the control arm while pregnant and lactating women consumed 210 ml more; Provision of livestock feeds to households was associated with 11% reduction in risk to acute malnutrition in children under fives.

Conclusion: Livestock feeding during critical dry seasons is associated with increase in milk production and consumption. Integrating nutrition counselling in livestock feeding programmes improves nutrition outcomes of children and pregnant and lactating women.

Keyword: Livestock programming, Nutrition counselling, Acute malnutrition, Milk production , Milk consumption

Further Collaborators: USAID

Concern orldwide

PACIDA

PAB(T8-45)
Development of LC-MS/MS method for determination of total choline in various foods using acid hydrolysis

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Background and objectives: Choline is present in foods as free choline and choline esters (phosphocholine, phosphatidylcholine, glycerophosphocholine, and sphingomyelin). Acid hydrolysis is a method to quantify total choline. The AOAC official method 2012.18 describes a method for hydrochloric acid hydrolysis Phosphocholine is not sufficiently hydrolyzed by this method and requires phospholipase D treatment. The AOAC Official Method 2015.10 describes a microwave-assisted nitric acid hydrolysis method. This method is convenient due to its short acid hydrolysis time but requires a high concentration. Additionally, AOAC 2012.18 and 2015.10 are limitedly applied to infant formula and adult/pediatric nutritional formula. In this study, we optimized the conditions for acid hydrolysis, and developed a method of determination of total choline that can be applied to various foods.

Methods: An acid solvent was added to the homogenized sample, and heat extraction was performed. The extract was diluted appropriately, and the amount of choline was measured by LC-MS/MS. To optimize acid hydrolysis, we compared the type of acid solvent (hydrochloric acid, nitric acid, sulfuric acid), acid concentration, extraction time, and equipment (autoclave, microwave). To confirm degree of hydrolyzation of choline ester, we measured the hydrolysis rate of phosphocholine and glycerophosphocholine. The optimized method was validated.

Results: The optimal conditions for acid hydrolysis were found to be an 8-hour extraction with hydrochloric acid (0.055 mol/L) in an autoclave (121 ℃). The hydrolysis rates of phosphocholine and glycerophosphocholine by this method were 97.8% and 100.7%, respectively. Furthermore, using egg yolk and chicken liver, we examined the extraction time, and confirmed that the total amount of choline peaked at 8 hours. Based on the established condition, we determined total choline of a standard reference material (NIST 1869 Infant/Adult Nutritional Formula II) and obtained the accepted data for the certified value.

Conclusions: In this study, we optimized the acid hydrolysis conditions for total choline analysis and established a method to convert choline esters in various foods to free choline. This method is safer, requiring lower acid concentrations than previous acid hydrolysis methods, and is a novel method that can measure total choline in various foods.

Keyword: choline, LC-MS/MS, acid hydrolysis, various foods

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-46)
Identification and characterization of percutaneously sensitizing fruit allergens

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Background and objectives: Recently, transdermal sensitization, in which food antigens enter through the skin and sensitize, has been attracting attention as a route for the development of food allergy. Fruits are used not only as food, but also in some cosmetics, and are often in contact with the skin. In this study, we investigated the dermal sensitization potential of cherries, kiwifruit (green/gold), and mangoes, and identified and characterized dermal sensitization antigens.

Methods: Six-week-old female BALB/c mice were divided into a control group and each fruit group. Once a week at the time of blood collection, the back of the head was shaved and tape-stripped, and 5% SDS was applied. Each sample was applied 4 times a week to each group. Only 5% SDS was applied for the control group and fruit extract/5% SDS for each fruit group, and serum levels of fruit specific IgE and IgG1 and the binding protein(s) of each antibody (candidate transdermal sensitization antigen) were detected by ELISA and immunoblotting (IB), and the antibody-binding proteins were purified by various chromatographic methods.

Results: Applied fruit specific IgE and IgG1 production was confirmed in each fruit group by ELISA. The IgE and IgG1 binding proteins were detected around 18, 23~25 kDa in kiwifruit, 27 kDa in cherry and 28 kDa in mango, depending on the IB. Obtained results suggest that these fruit proteins have transdermal sensitizing ability. Next, we purified and identified the sensitizing antigens and found kiwellin (Act d 5) in kiwifruit and thaumatin- like protein (Pru av 2) in cherry as the putative transdermal sensitizing allergens.

Discussion: Both kiwellin and thaumatin-like protein identified in this experiment are commonly found in plants and have a protective effect against infection. Therefore, it is suggested that the transdermal sensitization antigens of fruits might be related to plant defense proteins. In addition, it is notable that these proteins contain many S-S bonds in molecules. Identification of sensitizing antigens in mango is under progress.

Keyword: transdermal sensitization, allergens, mango, cherry, Kiwi fruit

Reference: 1) Izumi E., *et al*. Foods, 10, 134, (2021) 2) Kinugasa S., *et al*. Food Nutr. Res., 65: 7610, (2021)

PAB(T8-47)
Evaluation of Internal Structures in Rice Flours Using Small-Angle X-ray Scattering (SAXS) and Fourier Transform Infrared (FT-IR) Spectroscopy

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Background and objectives: Rice flour has both a nano-scale short-range ordered structure and a micro-scale long-range ordered structure. Physical conversion operations such as pulverization have controled of physical properties by disordering internal structures. Previous studies have shown that the milling method creates a core-shell structure in which only the surface is structurally changed and the internal crystal structure is maintained, and that it is possible to control disordered structure by humidity control. So, in this study, we attempted to evaluate the internal structure of rice flour with different milling methods by complementarily utilizing small-angle x-ray scattering (SAXS) and Fourier Transform Infrared (FT-IR) Spectroscopy.

Methods: White rice was pulverized using a jet mill to get six samples with a gradually different size (DM1-3 and WM1-3). α-formed sample was subjected to milling at 130°C.

Results: An order parameter using the SAXS curve was proposed to quantify the order structure of starch, and the true density was negatively correlated with the order parameter. In FT-IR spectrum, the band positions at 2927 and 990 cm^{-1} shifted to a lower wavenumber with an increase in the order parameter. Whereas the intensity of the band at 2927 cm^{-1} did not change, the intensity of the band at 990 cm^{-1}has a strongly negative correlation with the order parameter increased. When adjusting the moisture content of rice flour, the band position at 990 cm^{-1} shifted to a higher wavenumber above the water activity of 0.7. In addition, the band at 861 cm^{-1} also shifted to a higher wavenumber, whereas 572 and 436 cm^{-1} did not show a significant shift.

Conclusions: The order parameter was negatively correlated with the true density. This suggested that structural modification may have occurred at the lamellar structure (including amorphous /crystalline) level, and the ordered structure at lamellar level did not distributed densely. The behavior of the bands at 990 cm^{-1} > indicated the glass–rubber transition of starch owing to water sorption. These results demonstrate that the starch in rice flour formed a glass-like crystalline phase with low water activity and a rubber-like crystalline phase with high water activity.

Keyword: Fourier transform infrared , small-angle x-ray scattering, starch, water activity, milling

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T8-48)
Establishment of a recycling-oriented food production system using microalgae and mammalian cells

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Background and objectives: Although demand for meat is increasing due to a variety of problems, the existing meat production system has sustainability issues, as it accounts for 33% of the greenhouse gas emission. Cultured meat has been attracting attention as a new meat solution to this problem, but one of the challenges in its production is the problem of consuming large amounts of the cultured medium. In this study, we propose a new food production system that uses mammalian cells and microalgae for a complete recycling system to promote the use of cultured meats in the future. Microalgae remove metabolites such as ammonia that accumulate in mammalian cell culture, and basic nutrients are recovered from the proliferated microalgae and used as mammalian cell nutrients again. This new system makes it possible to produce cultured meat without discarding the cultured medium.

Methods: Primary chicken cells were cultured in a conditioned medium prepared by growth factor-secreting cells and culture medium. Thereafter the supernatant was sued to culture *Chlorococcum littorale* (*C. littorale*). The same conditioned medium was then used again to culture primary chicken cells. In this process, the sustainability of this system was examined by measuring nutrient components such as glucose and amino acids in the medium and metabolites such as ammonia and lactic acid.

Results: It was shown that chicken cells and *C. littorale* can be proliferated in the same conditioned medium. Furthermore, additional growth of chicken cells was confirmed by nutrient solution extracted from the *C. littorale* using a catalyst. In this process, it was confirmed that nutrients such as glucose and amino acids were supplied by the extraction of *C. littorale*, and at the same time, ammonia was utilized by *C. littorale* and removed from the culture medium.

Conclusion: The culture system shown in this study, in which mammalian cells and microalgae are co-utilized, is expected to enhance the feasibility of a recycling-oriented food production system and to be applied to the production of drugs, which consume large amounts of culture medium.

Keyword: Microalgae, Cultured Meat, Sustainability, Conditioned Medium

Conflict of Interest Disclosure: Tokyo Women's Medical University was receiving research funds from IntegriCulture Inc.

PAB(T8-49)
Improving household food security and nutrition through nutrition sensitive agriculture programming in Ghana.

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Background and objectives: Eradication of hunger and malnutrition is the second SDG that countries are working towards achievement by 2030. In Africa, the Malabo Declaration recommits to increasing food security and improving nutrition by 2025. To contribute to these goals, the Initiative for Food and Nutrition Security in Africa (IFNA), an initiative launched by the Japan International Cooperation Agency (JICA) and the African Union Development Agency NEPAD (AUDA-NEPAD), implemented pilot projects in three countries - Ghana, Mozambique, and Kenya, with the objective of increasing the production and consumption of locally adapted nutrient rich foods to address malnutrition. IFNAs two approaches include Multi-Sectoral Approach (MSA) and Nutrient Focused Approach (NFA).

Methods: The activities in Ghana were implemented in 19 communities in Krachi West district between June 2021 and January 2022. Aiming to reduce iron deficiency anemia, 500 small-scale farming households with pregnant or lactating women or with children under five years were targeted. The activities included: (i) Production of local nutrient rich vegetables and poultry - through health and agriculture extension workers training and farmer training; and provision of farming inputs (ii) Promotion of consumption of vegetables and eggs and dietary diversity in household meals through food and nutrition education. A baseline and an endline survey of the project was undertaken.

Results: Through the NFA, the district counterparts identified 12 locally available iron-rich vegetables for production and consumption. There was 121% increase in dietary diversity among women consuming between 6 and 9 food groups per day. There was 123%, 83% and 93% increase in consumption of green leafy vegetables, eggs and legumes respectively. 95% of project beneficiaries setup their own kitchen gardens compared to 24% at baseline. At the endline, project beneficiaries cultivated an additional 5 iron rich crops compared to baseline.

Conclusions: Setup of kitchen gardens close to households to increase iron-rich vegetable consumption. Food and nutrition education is critical for improving knowledge and practice in food preparation. Further research on evidence of hemoglobin level improvement through continued promotion of consumption of iron rich foods (among other routine community interventions) is required.

Keyword: Nutrition, Food security, Nutrient Focused Approach, Food production, Nutrition education

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Further Collaborators: None

Keyword: Plant defense proteins, Pantoea species, LC-MS/MS, Buckwheat seeds, Food allergens

Conflict of Interest Disclosure: The authors have no conflicts of interest directly relevant to the content of this article

PAB(T8-50)
Possibility of Isolating Plant Defense Proteins from Buckwheat Seeds

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Background and objectives: Plants exposed to various stresses such as infection and injury from pathogenic bacteria, chemical substances including plant hormones, air pollutants, and ultraviolet rays initiate defense mechanisms to protect themselves. A group of proteins induced in this process is defense-related proteins. Recently, such a protein becomes a cross-reaction-related allergen. These are called incomplete food allergens. In addition, the *Pantoea* species attached to buckwheat may become disease-causing germs and produce an antibiotic derived from peptides. Therefore, I investigated whether *Pantoea* species did not attach to buckwheat and analyzed the protein of the buckwheat which varied in the soil environment with LC-MS/MS.

Methods: *Pantoea* species isolated from 5 buckwheat seeds produce by each different area with a semi-selective Lysine-Ornithine-Mannitol-Arginine-Charcoal medium (LOMAC). The provided separation stock decided on a nucleic acid sequence after amplifying *gyrB* using the universal primer of the *gyrB* gene. We identified a bacterial species using DDBJ. The few grains of buckwheat's seed were ground into a fine powder using a mortar and pestle. After centrifugation, the supernatant was collected. After TCA precipitation, samples were digested with Trypsin. The digested samples were prepared for mass spectrometry analysis by GL-Tip SCX. The recovered peptides were analyzed using Q Exactive Plus coupled on-line with a capillary high-performance liquid chromatography (HPLC) system to acquire MS/MS spectra. Data derived from the MS/MS spectra were used to search the protein database SWISS-Prot using the MASCOT Server and to identify proteins using the proteome software.

Results: The authors have no conflicts of interest directly relevant to the content of this article. species were gathered from each 5 buckwheat seeds. The distinguished bacterial species were four kinds. The common bacterial species were The authors have no conflicts of interest directly relevant to the content of this article.Two proteins of the buckwheat seeds which varied in the area showed wide molecular weight. And six kinds of protein of the peptide range where expression was seen in only one buckwheat existed.

Conclusions: *Pantoea* species were found on all seeds. We couldn't clarify the possibility of external stress such as the infection of disease-causing germs. However, the distribution of proteins that grew up in a different environment differed. we suggested the possibility of isolating plant defense protein, such as incomplete food allergens.

PAB(T9-1)
Prevent COVID-19 while enjoying meals. ~My Meal Style Finding Challenge~

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Background and objectives: It is important to disseminate vital information to people to protect themselves and boost their health during the COVID-19 pandemic. Therefore, this initiative, called 'My Meal Style Finding Challenge' Project, provides individuals an opportunity to easily measure immune power (IgA: immunoglobulin A) in their saliva and gather helpful information to maintain immune power in their diet.

Method: A total of 79 people (including individuals and organizations) supported the project through crowdfunding. The participants took an immunological test, before and after the one-month meal challenge, to offer insights into changes in the immune system following lifestyle alterations based on meal choices. Once the participants became aware of their own immunity, we asked them to choose an easy-to-use food from 12 kinds of food to enhance immunity over a period of one month. The quantity and frequency of food intake was determined based on sex, age, and physical activity level.

Results: By encouraging healthy eating behavior and providing an opportunity to measure immunity, we were able to offer the participants an opportunity to reflect on their lifestyle. A detailed secondary analysis was performed with the permission of those participants whose immunological test values decreased after the meal challenge. We found that the degree of immune change varied, depending on factors such as participants' body temperature and environmental stressors.

Conclusion: The results indicated that the degree of change in immunity induced by the aforementioned meal challenge may vary based on the participants' background. In the future, we would take into account the background of the participants and chrono-nutrition aspects such as the timing of food intake. We would also like to extend this research into a longitudinal study for its social implementation as a public dietary intervention program that caters to personalized nutrition-based requirements

Keyword: COVID-19, personalized nutrition, IgA, intervention, meal challenge

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-2)
Factors influencing favourable and unfavourable dietary changes during the beginning of COVID-19 pandemic in Switzerland

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Background and objectives :The COVID-19 pandemic has largely impacted work and life patterns around the world including in Switzerland, where the most stringent measures against its spread were implemented during spring 2020. In this work, we aimed to assess the changes in dietary habits and looked at the sociodemographic and behavioural factors that might favour these modifications.

Methods: An online-survey was conducted among 980 adults representative of the Swiss population to estimate the changes in dietary habits between 13 March and 26 April 2020.

We designed a nutritional score to cluster the participants according to their dietary modifications: no change, positive or negative changes. Amount of eating, snacking frequency, consumption of fruits and vegetables, ready-to-eat meals, soft drinks, sweets and salty snacks were considered as dietary modification and used for scoring.

A multivariate logit regression was performed to examine whether the adherence to one of these three groups was associated with sociodemographic and behavioural factors reported in this survey.

Results: 31.8% (n=327) of the respondents did not show any change in their dietary behaviour. 319 participants were classified in the group with favourable changes (31.0 %), whereas 334 of them were in the cluster with unfavourable changes (32.5%).

Men tended to be fewer in the favourable cluster (OR: 0.71; 0.52-0.95). Furthermore, the subgroup of the population living in rural areas were significantly less likely to belong to the unfavourable changes cluster (OR: 0.41; 0.28-0.61). The odds of developing favourable dietary changes was higher in residential areas (OR: 2.26; 1.48-3.53). Becoming physically less active was a significant feature of the cluster with unfavourable changes (OR: 1.65; 1.14-2.41). Higher odds of unfavourable changes were observed among participants sitting more than usual over the study period (OR: 2.37; 1.67-3.38). Feeling mentally worse during the pandemic significantly increased a person's chance of developing unfavourable dietary changes (OR: 2.37; 1.67-3.38).

Conclusion: This survey indicated that no change, favourable and unfavourable related to dietary modifications were symmetrically distributed among the Swiss population. This part of the population developing unfavourable changes raises concern and public health policies need to specifically tackle this new appearance of unhealthy behaviours.

Keyword: COVID-19, dietary changes, Switzerland, behavioural factors, online-survey

PAB(T9-3)
Comparison of eating habits before and during the COVID-19 pandemic in elementary and junior high school students

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Background and objectives: The changes in children's attitudes toward their living situations during the coronavirus disease 2019 (COVID-19) pandemic have not been clearly studied. Therefore, this study aimed to compare attitudes toward school lunches, eating habits, and lifestyle habits in elementary and junior high school students before (2015) and during (2021) the COVID-19 pandemic. **Methods**: To determine attitudes prior to the pandemic, we distributed a questionnaire survey to 3rd, 5th grade students and 2nd-year junior high school students in A city in Japan (2015 survey). To determine attitudes after the pandemic, we distributed a survey using the Internet (2021 survey). The survey items were based on questions in the "2010 Survey Report on the Dietary Habits of Children for Japan Sport Council." **Results**: In total, 1,913 children in 60 schools answered the 2015 questionnaire, while 10,914 children in 97 schools answered the 2021 survey. In both the 2015 and 2021 surveys, over 75% of elementary school students answered that they "love" and "like" school lunch. Compared with the 2015 survey, in the 2021 survey of 3rd grade elementary school students, the items to be careful about when eating such as "do not drink too many sweet drinks such as juice," "do not eat too much salty food," and "rotate and eat rice and side dishes" were significantly reduced. Compared with the 2015 survey, in the 2021 survey, time spent exercising and playing outside were significantly reduced in all grade and junior high school students. Furthermore, the number of 2nd-year junior high school students who answered that they would go to bed after 24:00 was significantly higher in the 2021 survey. Moreover, "shared mealtime with family" was increased in the 2021 survey. **Conclusions**: These findings suggested that the influence of COVID-19 pandemic has affected the living conditions and eating habits of children.

Keyword: eating habits, lifestyle habits, COVID-19 pandemic, elementary and junior high school students, children

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-4)

Adherence to COVID-19 movement restrictions is associated with income loss and meal restriction in households with children under 5 in Guinea, Mali, Cote d'Ivoire and Burkina Faso.

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Background and objectives: The changes in children's attitudes toward their living situations during the coronavirus disease 2019 (COVID-19) pandemic have not been clearly studied. Therefore, this study aimed to compare attitudes toward school lunches, eating habits, and lifestyle habits in elementary and junior high school students before (2015) and during (2021) the COVID-19 pandemic. Methods: To determine attitudes prior to the pandemic, we distributed a questionnaire survey to 3rd, 5th grade students and 2nd-year junior high school students in A city in Japan (2015 survey). To determine attitudes after the pandemic, we distributed a survey using the Internet (2021 survey). The survey items were based on questions in the "2010 Survey Report on the Dietary Habits of Children for Japan Sport Council." **Results**: In total, 1,913 children in 60 schools answered the 2015 questionnaire, while 10,914 children in 97 schools answered the 2021 survey. In both the 2015 and 2021 surveys, over 75% of elementary school students answered that they "love" and "like" school lunch. Compared with the 2015 survey, in the 2021 survey of 3rd grade elementary school students, the items to be careful about when eating such as "do not drink too many sweet drinks such as juice," "do not eat too much salty food," and "rotate and eat rice and side dishes" were significantly reduced. Compared with the 2015 survey, in the 2021 survey, time spent exercising and playing outside were significantly reduced in all grade and junior high school students. Furthermore, the number of 2nd-year junior high school students who answered that they would go to bed after 24:00 was significantly higher in the 2021 survey. Moreover, "shared mealtime with family" was increased in the 2021 survey. **Conclusions**: These findings suggested that the influence of COVID-19 pandemic has affected the living conditions and eating habits of children.

Keyword: COVID-19, Food Insecurity, Income, West Africa

PAB(T9-5)

Coping strategy related to food insecurity among pregnant women in East Lombok District, Indonesia during the COVID-19 pandemic

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Background and objectives: The COVID-19 pandemic has negative consequences on livelihood and food insecurity. Food insecurity experienced during the vulnerable periods of pregnancy has a significant effect on maternal health and birth outcomes. This study aimed to describe coping strategies related to food insecurity during the COVID-19 pandemic among pregnant women in East Lombok Regency, West Nusa Tenggara Province, Indonesia

Methods: This cross-sectional study is part of a larger observational cohort study in East Lombok Regency, West Nusa Tenggara Province, Indonesia, entitled "UKRI-GCRF Action Against Stunting Hub (AASH)". The data collection was conducted among pregnant women aged 18-40 years old (n=470) in the third trimester of pregnancy (June 2021 to January 2022), including the interview about changes in household expenditure, income, and coping strategies related to food insecurity (RCSI) in relation to the pandemic situation. Hemoglobin, HbA1C, and Mid-Upper Arm Circumference (MUAC) were also assessed.

Results: Most respondents reported that their household income decreased (73.0%). As food prices rose, household food expenditures also increased (43.8%). However, only less than a quarter of the respondents received government food assistance during the pandemic. Coping strategies experienced by pregnant women were relying on less preferred and less expensive foods (66.8%); restricting adult's consumption to prioritize children (29.1%); borrowing food or relying on help from a friend or relative (28.7%); limiting portion size at mealtimes (25.5%), and reducing the number of meals eaten in a day (19.6%). Among them, 40.6% were anemic (Hb< 11.0 g/dL), 15.3% had chronic energy deficiency (CED; MUAC < 23.5cm), and 8.5% had gestational diabetes mellitus.

Conclusion: The COVID-19 pandemic significantly affected the food security of pregnant women. Pregnant women practiced coping strategies to adjust to the pandemic situation, which may have negative consequences on the pregnancy condition and birth outcomes. Further studies to explore the dietary intake of pregnant woman related to their coping strategy and their nutritional status is needed.

Keyword: COVID-19, pregnant women, food security, coping strategies

Conflict of Interest Disclosure: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-6)
Long Covid in Africa – a hidden storm?

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Background and objective: Long Covid (LC) is defined as a condition that occurs in individuals after a confirmed SARS coV-2 infection or a history of a probable infection with symptoms that cannot be explained by another diagnosis and last for at least 8 weeks. This can be symptoms persisting from an initial illness, or new symptoms following initial recovery from a Covid-19 infection. The aim was to investigate what is known about LC in Africa and compare prevalence to Western world Methods: So far, only two studies on LC have been conducted in Africa, South Africa to be precise. Results: The studies reveal different proportions of LC. One showed that 60% of patients with mild Covid-19 had persistent symptoms after one month and 35% after two months, while the other showed that 82% of patients with severe Covid-19 had persistent symptoms or reported new symptoms one month after and 67% after three months. In more Europe and US the prevalence has been found to be much lower where 13% had LC after a month, 2,3% reported symptoms after 8 weeks and as low as 2,3% after 12 weeks.

Conclusion: These numbers are a cause of concern. The differences could be related to the severity of the Covid-19 illness, ethnicity or even the low vaccination rate. Furthermore, physicians still advise preventing nutritional deficiencies, as a way to prevent or reduce the likelihood of developing LC. With the African continent being among the most nutritionally deficient regions, especially in terms of vitamins and minerals important for the functioning of the immune systems, this could also explain the higher prevalence of LC in South Africa. The effects of LC extend beyond physical effects but also affects productivity, and thus struggling economies like those of many African countries. There is need for more robust research into LC within the continent. It is also important to increase awareness about this condition and debunk myths within the communities. Given the low level of attention that the continent currently gives LC, institutions and funding agencies need to increase this attention so that Africans are not left behind

Keyword: Long Covid, Africa

Conflict of Interest Disclosure: None

PAB(T9-7)
Impact of COVID-19 pandemic on HIV and TB control and care in Zimbabwe: A situational analysis

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Background: Africa is the most affected region with HIV, with 25.4 million [20.7 million to 30.3 million] living with HIV in 2020. **Objective**: To assess the impact of COVID-19 pandemic on HIV and TB management in Zimbabwe. **Method**: A mixed-methods approach was used. Primary data was obtained from a desk review, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs). While secondary data from the demographic and health information system DHIS-2 was analysed using a retrospective longitudinal (time series) approach. **Results:** The first COVID-19 case in Zimbabwe was reported on 21 March 2020. Our study revealed that there was a large negative impact on almost all aspects of HIV and TB case detection, diagnosis and treatment after onset of COVID-19. During lockdowns, travel restrictions and closure of some health facilities affected access to service delivery by patients. There was a drastic drop in HIV testing coverage (December 2019) and a decline in numbers initiated on ART (January 2020 to April 2020). TB notifications also declined in the COVID-19 period. **Conclusions:** COVID-19 associated lockdowns and travel restrictions disrupted health delivery in Zimbabwe particularly in urban settings. In general, HIV and TB preventative services like condom distribution and voluntary male circumcision were affected more compared to curative activities. The closure of nightclubs and prostitution hotspots resulted in a decline in new HIV infections. The impact of COVID-19 on HIV and TB patients was more pronounced in children, adolescents, women, and men who have sex with men (MSM).

Keyword: COVID-19, HIV, TB, lockdown, Zimbabwe

Conflict of Interest Disclosure: None

Further Collaborators: N/A

PAB(T9-8)

Patterns of change in depression symptoms before and during COVID-19-related community quarantine among adolescents in lowland rural communities in the Philippines

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Background and objectives: The COVID-19 pandemic reportedly can increase mental health problems among children. Data on this association are sparse in Filipino adolescents. We aimed to identify and describe depressive states in selected adolescents from lowland rural communities in Nagcarlan, Laguna, Philippines before and during community quarantine (indicated by times T1 and T2). Additionally, we sought to identify patterns of changes in depressive states over time.

Methods: The Short Mood and Feelings Questionnaire (SMFQ), a depression screening tool, was accomplished by 285 participants aged 10-16 years before the COVID-19 pandemic (October-December 2019) while a subsample of 153 participants accomplished the questionnaire in August to September 2020, five to six months after the declaration of the quarantine in March 2020. Latent Markov (LM) analysis was used to identify predictive factors of depressive states at T1 and T2. Variables examined include weight, height, HAZ, measures of wellbeing, internal and external pressures to conform to societal ideal of body appearance, energy and nutrient intakes, food security, and biochemical parameters. Forward selection of blocks of covariates was undertaken to determine the final model, which was adjusted for socio-demographic variables, BAZ, physical activity, and inflammatory indicators.

Results: We identified three distinct states of depression that represented a development trend from non-depressed to a depressed state. At T1, factors found to be protective against anxiousness and depression were higher scores for happiness, higher serum zinc levels, and food security. In contrast, higher scores for internal pressure to be thin and media pressure to conform to a certain body appearance, and higher serum levels of soluble transferrin receptor increase the likelihood to anxiousness and depression. Depression decreased from 23.7% to 14.4% from T1 to T2. About 5% of the non-depressed transitioned to a depressed state while two-thirds of the depressed participants transitioned to a non-depressed state. None of the abovementioned covariates were found predictive of the transitions in class membership at T2.

Conclusion: In this study population, we found no evidence that COVID-19-related quarantine was accompanied by an increase in depression.

Keyword: Depression, Adolescents, Nutrition, Philippines, COVID-19

Conflict of Interest Disclosure: This study was funded by the Nutricia Research Foundation (NRF). Some support was also received from Unilab Inc., Gardenia Philippines, National Nutrition Council, Food and Nutrition Research Institute-Department of Science and Technology for tokens and instructional materials provided to the participants. LP Mughal received salary from NRF. At the time of data collection, LP Mughal was a consultant for Unilab Inc., a company that markets and sells various products that include micronutrient supplements. None of the abovementioned companies or government agencies had any participation in the design, implementation, data analysis, and write-up

PAB(T9-9)

Relationship between ABO blood group distribution and clinical characteristics in Covid-19 patients

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Background and objectives: Since the onset of Covid-19, scientists have been studying the risk and susceptibility factors for developing this disease. Among these factors, LANDSTEINER's ABO blood types were also considered to be biological elements that could determine the susceptibility of a patient with Covid-19 to present a number of symptoms and/or a severe form of Covid-19. The objective of this study is to explore the relationship between the blood type (ABO) and the clinical and epidemiological characteristics in Covid-19 patients.

Methods: A total of 786 patients were included in this retrospective case-control study, seen in an outpatient consultation at the Covid-19 service level. Patient data from the four blood groups A, B, O, and AB were collected and clinical and epidemiological characteristics were studied and analyzed.

Results: The average age of the population studied is 45.58 years with a predominance of women (52.9%) compared to men (47.1%). Results of this study show that the distribution of different blood groups is the majority for the groups O and A with the prevalences of 42.2% 31.5% respectively, while the groups B and AB show only 18.8% and 7.5% respectively. Overall, the majority of patients with diabetes, hypertension, heart disease, and chronic respiratory disease present the Group O. In addition, analysis of the presentability of clinical signs and the specific symptoms of Covid-19 shows that the prevalence of certain clinical signs such as fever, myalgia, asthenia, dyspnea,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

anosmia and agueusia were significantly elevated in patients with O and A blood types.

Conclusions: Covid-19 patients with the O and A blood types are at higher risk of presenting a severe clinical and prognostic picture related to Covid-19 compared to patients with the other blood types (B and AB).

Keyword: Covid-19, Clinical characteristics, Blood group, Moroccan patients

PAB(T9-10)

The occurrence of stunting among the under-five-year old children during the Covid-19 pandemic at Kuntum Mekar Integrated Health Post Depok Municipality, West Java, Indonesia

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COVID-19 pandemic could challenge the nutrition fulfillment case, especially for under five-year-old children in low-middle-income countries, including Indonesia. Infection in children could be worsened by malnutrition, contributing to virus transmission. Local healthcare facilities monitored the nutritional status of under five-year-old children, particularly during the pandemic. This study aimed to identify the nutritional status of under-five-year-old children during the COVID-19 pandemic in the Integrated Health Post "Kuntum Mekar" in Depok District. This research used secondary data analysis. The study results involved 135 data from subjects included in the analysis. Those are one newborn (0-3 months old) who did not experience stunting, 27 toddlers (4-12 months old) with a stunting percentage of 7.4% and severe stunting of 3.7%, 31 children (13-23 months old) with a stunting prevalence of 12.9% and severe stunting 3.2%. Twenty-seven children ((24-35 months old) had a stunting prevalence of 14.8%, 22 children (35-47 months old) had a prevalence of stunting at 22,7%, and 4,5% of them were severe stunting. At last, the children aged 47-59 months old had a prevalence of stunting at 14,8%. The stunting eradication program required multi sectors approach to reach the goal of gold generation in 2045.

Keyword: COVID-19 Pandemic, malnutrition, stunting, Depok

Conflict of Interest Disclosure: None

PAB(T9-11)

Comparison of eating places and food types between food secure and insecure groups: Before, during and after the COVID-19 pandemic

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Background and objectives: The COVID-19 pandemic has caused substantial changes in dietary lifestyle. The purpose of this study was to compare eating places and food types between food secure and insecure groups before (year 2019), during (year 2021), and after (year 2022) the pandemic among South Korean adults.

Methods: The nationwide online survey was conducted with 2,196 adults aged 20~65 years in July 2022. The household food security during the year preceding the survey was assessed by using a question employed in the Korea National Health and Nutrition Examination Survey.

Results: About 88% (88.2%) of the respondents were classified into the food secure group and the rest (11.8%) were classified into the food insecure group. The frequency of eating home increased in both groups during the pandemic. The proportions of the respondents eating home were higher in the secure group than the insecure group across the three periods, and the gap between the two groups has grown; 84.0% of the food secure group and 76.2% of the food insecure group ate at home more than once a week during the pandemic (p=0.002). On the contrary, the proportions of the respondents eating at convenience stores were two times higher in the insecure group than the secure group across the three periods. The pandemic has widened the gap between the two groups; 21.8% of the secure group and 43.5% of the insecure group ate at convenience stores more than once a week after the pandemic ($p< 0.001$). The insecure group consumed ready-to-eat (RTE) foods more frequently than the secure group across the three periods. The difference in proportions of the respondents consuming RTE foods between the two groups has grown after the pandemic; 22.7% of the food secure group and 43.5% of the food insecure group consumed RTE foods more than once a week after the pandemic ($p< 0.001$).

Conclusions: The COVID-19 pandemic has intensified the differences in the food insecure group. Such differences between the food secure and insecure groups prompt the government to consider new measures in food and nutrition policy and programs in the new normal era.

Acknowledgement: This research was supported by a grant (22192MFDS093-1) from Ministry of Food and Drug Safety in 2022.

Keyword: COVID-19, coronavirus disease, pandemic, food security, dietary lifestyle

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-12)
Food and Nutrition Security in the Philippines During the COVID-19 Panemic

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The COVID-19 pandemic placed the Philippines' food and nutrition issues front and center. The national government was swift to impose countermeasures that were designed to prevent food system disruptions. Distribution of food and financial assistance were extensive albeit rather insufficient considering prolonged lockdown restrictions. Constantly changing community quarantine guidelines affected movement of food supply, delivery of health services, and household economic security. Nutrition programs such as vitamin A supplementation, feeding for children, and micronutrient supplementation for pregnant women had lower coverage rates and by the latter half of 2020, the country reached its highest recorded hunger rate. Cases of both undernutrition and overnutrition are predicted to rise because of dietary imbalance and a variety of factors. Conversely, community members and some local government units took it upon themselves to improve the food situation in their areas. Provision of food packs containing fresh fruits and vegetables were lauded as it exemplified a conscious effort to deal with nutrition security. Efforts to address food security has always been about increasing accessibility, availability, and affordability – often neglecting the nutrition component of foods. Strategies that incorporate nutrition security in food security are much needed in the country, especially during emergency situations such as a pandemic.

Keyword: food and nutrition security, Philippines, COVID-19 pandemic

PAB(T9-13)
Low Social Support is Associated with Maternal Depression among Pregnant Women during COVID-19 Pandemic in Rural Indonesia

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Background and objective: Maternal depression during pregnancy has an adverse effect on the newborn, however there is lack of information on maternal depression during pregnancy in the period of COVID-19 pandemic. This present study aims to investigate the prevalence and determinants of maternal depression in pregnant women during COVID-19 pandemic in East Lombok, Indonesia.

Methods: This cross-sectional study was a part of larger observational cohort study in East Lombok, West Nusa Tenggara, Indonesia entitled "UKRI GCRF Action Against Stunting Hub (AASH)". Pregnant women in trimester-2 were recruited (February 2021 – September 2021) in this study. Sociodemographic and socioeconomic information was obtained from interview using structured questionnaire. Chronic energy deficiency (CED) was determined using mid-upper arm circumference (MUAC) < 23.5 cm. Edinburgh Postnatal Depression Scale (EPDS) was used to measure maternal depression. Global Measure of Perceived Stress (GMPS) was used to measure maternal stress and Multidimensional Scale of Perceived Social Support (MSPSS) was used to measure social support. These were administered by trained enumerator.

Results: A total of 702 pregnant women aged 18-40 years old were included in the analysis. Most of the pregnant women (66%) were completed secondary education. Maternal depression (EPDS >9) and moderate-high stress (GMPS >18) were experienced by 26.6% and 86.3%, respectively. Majority (65.2%) of pregnant women reported high social support (MSPSS >5). The prevalence of CED was 22.5%. Maternal depression was significantly associated with CED (OR = 1.56, 95% CI = 1.06–2.30, p = 0.024) and with maternal stress (OR = 5.38, 95% CI = 2.44–11.82, p < 0.001). Multivariate logistics regression, after adjusted with age and maternal education, showed that low-moderate social support (AOR = 1.75, 95% CI = 1.22–2.49, p = 0.002) was significantly associated with maternal depression. Friends provided less social support (36.1-58.5%) than partners (83.0-88.7%) and family (81.0-92.3%).

Conclusions: Low social support was significant determinant of maternal depression during pregnancy. Effort to improve social support may include improving friends support for pregnant women in this study area.

Keyword: maternal depression, stress, CED, social support, pregnant women

Conflict of Interest Disclosure: None

PAB(T9-14)
Household food waste and its determinants in urban and rural areas in southern Thailand

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Background and objectives: Food loss and waste occurs at every stage of the food supply chain and threatens the global food security and sustainability. At consumption stage, food waste is mostly generated in households. Currently, there is insufficient data on household food waste in middle-income

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

countries, including Thailand. It is suspected that previous estimates of food waste from households may be underestimated. This study aimed to determine the amount of households' wasted food and the determinants of food wastage in urban and rural areas in southern Thailand

Methods: This cross-sectional study was conducted in 104 single-family households in representing urban and rural areas in southern Thailand during July-August 2021. The quantity of households' wasted food was self-reported on 2 weekdays and 1 weekend day. Behavior, attitude and awareness towards food waste of consumer and person responsible for food purchasing and preparation in each household were assessed using a validated self-administered questionnaire (content validity index=0.97, Cronbach's alpha=0.77).

Results: On average, the amount of food waste in households in urban area was 101.99 g/capita/day, which was significantly higher ($p < 0.001$) than that of rural households (83.18 g/capita/day). Majority of urban household members reported that they never thrown away most food groups, except bread and bakery products, and fruits and vegetables that were rarely and sometimes discarded, respectively. For most rural households, all food groups were wasted at the higher frequencies than did those of urban households, except fruits and vegetables. Based on the correlations between food waste quantity and household behavior, the factors that influence household food waste were moral norms, and perceived behavioral control of the consumer in household ($p < 0.01$). Shopping routines, planning routines, and household skills of household food buyer were also contributed to the households' wasted food.

Conclusions: The amount of household food waste was influenced by socioeconomic factors, as well as behavior, attitude and awareness towards food waste among the household members. Therefore, different strategies should be implemented for food waste reduction in urban and rural households. This study might be preliminary baseline data on household food waste in Thailand and other middle-income countries with similar context.

Keyword: Food loss and waste, Household, Food waste quantification, Food waste behavior, Consumer behavior

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PAB(T9-15)
Improving the food environment through providing healthy meals in a food service business: Declaration of commitment to Tokyo Nutrition for Growth Summit 2021

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Background and objectives: The Tokyo Nutrition for Growth Summit 2021 established a vision that encourages stakeholders to make a commitment to support the achievement of international nutrition goals aligned with the international priorities in nutrition. We examined how our food service business could make a meaningful commitment.

Methods: Our business provides meals to customers in designated food service facilities such as offices, dormitories, and universities We examined how we can contribute to to the following targets: Sustainable Development Goals 2.2 (end malnutrition in all forms) and 3.4 (reduce mortality from non-communicable diseases) and World Health Assembly targets on undernutrition, breastfeeding, non-communicable disease (NCD) and obesity, identified as international priorities in the commitment-making guide. We surveyed the current status of our food service and based on the findings, we set an ambitious goal for the commitment.

Results: In October 2021, 62.2% of the contracted facilities where our head office can check and change the menu provided healthy meals. Healthy meals were defined as those that contribute to the goals of reducing salt intake by 30%, reducing hypertension by 25%, and preventing the increase of diabetes and obesity. These are the global targets for the prevention and control of NCDs, which can be targeted at a food service business as an international priority. The final goal was set to provide healthy meals at 100% of the facilities by 2025, Actions to achieve the goal included (1) co-developing and providing delicious low-sodium meals /processed foods; (2) encouraging all customers, including those who may not focus on their health, to make healthy food choices by adding value to food, for example by providing healthy meals at events; and (3) educating registered dietitians/ nutritionist and licensed cooks who work at worksite cafeterias on how to provide healthy meals.

Conclusions: Our food service business aims to maintain and promote the health of our customers. We believe that improving the food environment can contribute to the achievement of the international priorities of nutrition. Our aim is to continue improving the food environment toward 2025.

Keyword: Food Service, healthy meals, Tokyo Nutrition for Growth Summit 2021, worksite cafeteria, healthy food environment

Conflict of Interest Disclosure: None

PAB(T9-16)
Weaning Food Situation and Challenges in Developing Countries - From a JICA Overseas Cooperation Volunteer Dispatch Country-

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Background and objectives: One of the targets of the Sustainable Development Goals is to is to end preventable deaths of newborns and children under 5 years of age by 2030, and although the mortality rate is decreasing year by year, there are still many malnourished and stunted children. The purpose

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of this study was to understand the current state of nutrition in developing countries and to identify issues that need to be addressed.

Methods: A questionnaire on weaning food was administered to members of the Japan International Cooperation Agency (JICA) who were dispatched to developing countries to work as volunteers as part of Japan's Official Development Assistance program. The survey items included the content of the first bite, introduction age, and opportunities for parents to learn about weaning, etc. Simple and cross tabulation was conducted on the responses of 40 volunteers dispatched to 23 countries.

Results: The target regions were as follows: Asia, Africa, Oceania, and South America, with 65% in urban areas and 35% in rural areas. 42.5% of the respondents started weaning at 5 to 6 months, 50% of cases used seasonings from the beginning, and the first bite being the staple food in all regions. 52.5% of the respondents reported that guidance and opportunities to learn about weaning (information sources) and were mostly from family members or parents. Comparing urban and rural areas, 71.4% of rural areas had only familial guidance when learning about weaning. In 30% of cases, there were no national or regional guidelines for weaning food. In addition, in more than 77% of the countries, respondents were concerned about nutritional balance and hygiene. A small number of respondents stated that they were struggling to survive and that their children were taking care of them.

Conclusion: In order to avoid preventable deaths, it was suggested that expert knowledge and learning opportunities should be provided, and if there are no official national or regional guidelines, then guidelines should be developed to suit the diet and lifestyle of the country. These results are just the tip of the iceberg, and more information should be collected through surveys of the affected people.

Keyword: Weaning Food, Developing countries, Under 5 mortality rate, Malnutrition, Sustainable Development Goals

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PAB(T9-17)
Can a combined agriculture and nutrition behaviour change intervention improve women's empowerment in rural Bangladesh? A feasibility study.

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Background and objectives: Many agricultural and home gardening interventions aim to improve the nutritional status of women and children in low- and middle-income countries by focusing on women as the recipient of the intervention and make assumptions that women will be empowered as a result. This research examines the potential impact of an intervention that combined home garden training and support, and nutrition behaviour change communication, with a social safety net payment, on women's empowerment in rural Bangladesh.

Methods: Twenty in-depth interviews were conducted with randomly selected women that took part in the study. Qualitative data was coded using the following five indicators: control over use of income, input into productive decisions, respect amount household members, self-efficacy and input into nutrition and health care decisions. We assessed the implementation of this study in terms of feasibility, acceptability, and practical application. Results: Our study showed that a combined nutrition-specific (nutrition counselling) and nutrition-sensitive (agricultural training and unconditional cash transfer) intervention, delivered on a mobile platform, to women from low-income families in rural Bangladesh was feasible and acceptable. The study further revealed evidence on behaviour change across five key areas related to women's empowerment.

Conclusions: The study highlights the potential for such an intervention to impact women's empowerment and provides insight for the aid in the design of larger-scale trials implemented in similar settings

Keyword: Nutrition behaviour change communication, nutrition-sensitive agriculture, women's empowerment, social safety net, qualitative methods

Conflict of Interest Disclosure: None

Further Collaborators: N/A

PAB(T9-18)
Voluntary cooperation between the food industry and government for a healthier diet in the population—the case of Norway

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Background and objectives: In Norway, there has been an initiative since 2017 to make the population's diet healthier through a voluntary agreement between the food industry and health authorities. The letter of intent has been signed by around 100 actors including the Ministry of Health and Care, and all the major actors in the food industry—food and trade organizations, food and beverage manufacturers, food retailers and food service industry. The overall aims of the initiative are to reduce the intake of salt, added sugar and saturated fat in the population, and to increase the consumption of vegetables, fruits and berries, whole grain products and seafood.

Methods: The initiative has been followed by a formative evaluation, including annual surveys to agreement partners from 2017 to 2021 and qualitative interviews with stakeholders from industry, organisations, and government in 2018, 2020 and 2022.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Results: The different measures utilised by the actors varied as expected, according to the aims. For the reduction of salt, sugar and fat, gradual changes over time and development of new products were the most dominant measures used by the actors. While for the increased consumption of vegetables, fruits and berries, whole grain products and seafood, marketing initiatives and changed product placement has been important. A few similar initiatives have been initiated earlier in other countries, however most of them has failed when government has changed. The Norwegian initiative is unique in the sense that it has survived changes of government. It is based on trust between the industrial partners and the health authorities. Both sides highlighted the value of a common meeting place.

Conclusion: The cooperation among partners becomes easier when they can settle upon meetings and discussions regularly. In addition, a strong motivation for the actors is to address public health as part of their corporate social responsibility. The contract thus contributed to an already shared objective between the partners and the authorities. Even though there have been challenges during the agreement period, the parties find the voluntary cooperation a useful way to work and have signed a new agreement for the period 2022-2025.

Keyword: Public–private partnership, Healthier diet, Norway

Conflict of Interest Disclosure: None

Further Collaborators: No

PAB(T9-19)
Building the capacity of consumers to demand diverse, safe and nutritious food

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Background and objectives: Food systems are complex and are neither nutrition nor health driven. The decisions made at any stage of the food supply chain have implications on consumer choices, dietary patterns, and nutritional outcomes. How food is grown, distributed, processed, marketed, and sold determines which foods are available, affordable, and acceptable within the local cultural context. These factors guide food choices, influencing the quality of people's diets, and hence play a vital part in health. Food systems are broken and therefore guidance on nutritious food choices and diets are required. The objective of this presentation is to describe the actions required to enable consumers to demand diverse, safe and nutritious food.

Methods: Literature was reviewed, analysing different databases, and case studies to provide a synopsis of current knowledge and viewpoints on barriers and actions needed to enable consumers to make nutritious, healthy and culturally acceptable food choices. Given the nature of the topic, a broad search approach was used. Scientific databases were searched starting with the search string: “food systems”, with “food production”, “post-harvest practices”, “food choices” and “nutritious diets” as secondary search terms. Additionally, websites of international organisations linked to food systems research were interrogated.

Results: Actions and their impact that are required include those made by public institutions such as School feeding programs, business incentives, regulations and legislation, education and public awareness, as well as national guidelines. Investment and incentivised initiatives are needed to foster diverse food production, influence consumers' behaviour and consumption.

Conclusions: Food system transformation at the consumer level enable the consumer to make healthy food choices more of a default and effortless, thereby relying less on individual self-control and more on changes in the environment and social standards.

Keyword: Food systems, Food choices, Nutritious foods, Diets, School feeding program

Conflict of Interest Disclosure: None

PAB(T9-20)
The utilization of technology in food production in the context of sustainable food system and planetary health

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Background and objectives: Rapid growth of population and global climate change require the robust system of sustainable food production. At the same time, given the concept of “planetary health”, it is anticipated to minimize negative impact through food production against environment in order to pursue improved health and environmental benefits. To do so, objective monitoring and evaluation would be important. For example, there are global certification framework which assure sustainability via biological safety, chemical safety, and so on. However, the number of food acquiring global certification is quite limited in Japan. So, we aimed to find the bottleneck of this situation and explore the good example of sustainable food production in Japan.

Methods: Literature review and depth interview was adopted.

Results: As the major bottlenecks, following factors were suggested; 1)complicated recording work to prove sustainability, 2) low perception about global certification among food producer as well as consumer, 3) high cost of obtaining the certification, 4) aging and labor shortage in agriculture and fishery. Meanwhile, pioneering food producers are producing crops and marine products in a sustainable manner by utilizing digital devices for efficient sensing and recording. Also, precise climate data from satellite is now

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DOI: 10.1159/000530786

available for appropriate prediction of resource allocation and waste reduction.

Conclusions: Although there are several bottlenecks to generalize sustainable food production, appropriate intervention such as sustainability education targeted at food producer and consumer would be an option to improve the situation. By doing so, the significance of sustainable food system will be enlightened and the changes of food production and purchasing behavior are expected. Also, the database of feasible and widely applicable method of sustainable food production is anticipated in order to meet Sustainable Development Goals(SDGs).

Keyword: planetary health, food production, sustainable food systems, agriculture, aquaculture

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PAB(T9-21)
Ensuring integrity in science: Updated guiding principles for funding food science and nutrition research

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Background and objectives: While the food and beverage industries play a critical role in advancing food safety and nutrition science, research funded by the private sector is subject to intense scrutiny as a result of various perceived and real biases related to funding source. The Institute for the Advancement of Food and Nutrition Science (IAFNS) [1] Assembly on Scientific Integrity has updated its Guiding Principles for Funding Food Science and Nutrition Research (Rowe et al, 2009) to provide a modernized framework for minimizing bias in industry-supported research.

Methods: To inform the development of the revised Guiding Principles, a team of public and private sector scientists discussed common concerns related to bias in industry-funded research and evaluated existing best practices for managing conflicts and maintaining trust in science. Feedback on the draft updates provided by a set of external stakeholders, including those from nutrition and food safety professional societies.

Results: The updates to the Guiding Principles aim to address common criticisms of industry-funded research. The revised Guiding Principles encourage greater transparency of interactions between funder and investigator, strengthen the guardrails that separate the funding from the science, and reflect the shift within the scientific community toward increased transparency and open science.

Conclusions: The revised Guiding Principles for Funding Food Science and Nutrition Research provide a modernized framework for separating the science from the source of funding, and for facilitating the advancement of transparent, credible research. If they are followed as intended, other than to debate the science itself, there should be little reason to dispute a resulting study.

[1]Now an independent organization, IAFNS evolved from ILSI North America

Keyword: conflict of interest, research integrity, transparency, disclosure, peer review

Conflict of Interest Disclosure: This work was supported by the Institute for the Advancement of Food and Nutrition Sciences (IAFNS) Assembly on Scientific Integrity. IAFNS is a nonprofit science organization that pools funding from industry collaborators and advances science through the in-kind and financial contributions from public and private sector participants.

PAB(T9-22)
What have global businesses pledged to transform nutrition and food systems? Examining the Business Constituency Group's 2021 Tokyo Nutrition for Growth (N4G) Summit commitments to support the Responsible Business Pledge for Better Nutrition.

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1. Virginia Tech (USA)

Background and Objectives: Transnational food and beverage companies and business organizations have important resources to influence and reach billions of people worldwide to promote safe and healthy high-quality diets within resilient, equitable, and sustainable food systems. The Business Constituency Group (BCG) represents six global business organizations that released voluntary commitments at the 2021 Tokyo Nutrition for Growth Summit (N4G) to support the Responsible Business Pledge for Better Nutrition. Methods: We examined relevant evidence to identify the BCG organizations, summarized their voluntary commitments, and explored 21 food and beverage BCG firms and pledges. We compared selected BCG members' N4G commitments to expert recommendations, examined business performance scores based on the Access to Nutrition Index and World Benchmark Alliance scores, and explored accountability processes to assess and report on progress toward implementing their N4G commitments. Results: Many voluntary nutrition pledges made by business organizations and transnational agri-food and business firms at the Tokyo N4G summit are unambitious and fail meet this moment to transform nutrition and food systems. Conclusions: The six BCG participants should expand its membership, strengthen their commitments, and enhance transparency and

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

accountability processes further to meet the Responsible Business Pledge for Better Nutrition

Keyword: voluntary commitments and pledges, food systems, business, accountability, nutrition

Conflict of Interest Disclosure: No conflict of interest. PBH and VIK did not receive any funding from the commercial or private-sector entities for research or consulting and have no conflicts of interest related to the content of this manuscript. This research did not involve human subjects and therefore, was exempt from institutional review board requirements.

Further Collaborators: N/a

PAB(T9-23)

Maximising nutrition: from theory to practice using a stepwise impact pathway approach

Integrating nutrition into agrifoodsystems: from theory to practice

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Background and objectives: Malnutrition is exacerbated by gaps within the agrifood system. To address these gaps, the Food and Agriculture Organization of the UN together with World Vision, Action Contre la Faim and twelve country teams in Sub-Saharan Africa developed a participatory methodology that engages key actors across agrifood systems – from eco-systems to the production, processing, retail, consumption and disposal of food. The Impact Pathway (IP) approach focuses on the most vulnerable communities that are largely dependent on natural resources to sustain their economy, basic services, food security and dietary needs.

Methods: The IP approach involves a consultative stepwise methodology that solicits inputs from key stakeholders such as project formulators, target communities, policymakers, private businesses, and academia. In alignment with the high level panel of experts food systems framework, the scope of the Impact Pathways approach is tailored to a sub-sector, region, local community or food commodity. The scope, or problem statement, is used to form a Theory of Change, which is a diagram that gives a comprehensive description of why and how a desired change is expected. From this Theory of Change, several Impact Pathways with their own specific assumptions, trade-offs and gaps are drawn through a participative process. Activities and related information are mapped along the Impact Pathways to help decision makers with prioritizing and planning. In addition, external drivers that define cross-cutting issues are examined throughout the results chain.

Results: Implementing this approach provides decision makers with an accessible, common approach to monitoring ongoing field interventions, identifying gaps, establishing milestones and supporting final evaluations. It allows key entry points to be identified and optimised to best improve dietary diversity for key stakeholders within agrifood systems.

Conclusions: An agrifood systems approach allows key stakeholders to identify entry points for intervention without losing sight of how their collective work can lead to improved availability, accessibility and consumption of healthy diets. The involvement of vulnerable groups is critical to ensuring that opportunities and potential risks are adequately considered in the design and implementation of policies and programmes aimed at improving their health and socio-economic outcomes and increasing their resilience to environmental shocks and stresses.

Keyword: Impact pathways, Theory of Change, Agrifood systems, Consultative stepwise approach, Vulnerable communite

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PAB(T9-24)

Food and nutrition policy and action in China: past, present, and future

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Background and objectives: Countries across the world have introduced a wide variety of policies to improve nutrition. While there has been increased nutrition policy attention to improving public health in China, there is a lack of summary on previous policies.

Methods: This review used the literature review to evaluate the Chinese government's nutrition policies. We also provide recommendations for how best to ensure future nutrition policies are genuinely implemented and likely to have a meaningful impact on public health.

Result: Categorizing and integrating Chinese nutrition works since 1949; summarizing the most critical nutrition policies, actions, guidelines, and standards at each stage; and explaining the significance of these documents in promoting public health. At the same time, we provide 4 suggestions on implementing China's nutrition policy from the aspects of legislation, nutrition monitoring, stakeholder cooperation, and nutrition education.

Conclusion: Encouragingly, the Chinese government is engaged in activities intended to increase Chinese citizens' health. Also, lots of policies have shown the effect on nutrition promotion. More needs to be done in China to implement the most potentially powerful nutrition policies, especially legislation.

Keyword: Public Health, Nutrition policy, Evaluation, China

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-25)
Resilient Community Nutrition Groups in Times of Crisis in Centre Nord, Burkina Faso

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Background and objectives: USAID-funded Victory Against Malnutrition Plus (ViMPus) aims to increase household food/nutrition security in Center Nord, Burkina Faso. Ongoing inter-communal violence and clashes are causing displacement, disrupting local economies and community-level activities/services. Community Nutrition Groups known as GASPA supported by ViMPlus have proven to be resilient, shock-responsive and inclusive platforms to respond to community needs in real time. ViMPlus has contributed to establishing 2,153 GASPAs (including the participation of 1,369 internally displaced persons (IDPs)) in 182 villages.

Methods: Led by "Mamans Leaders", GASPA lead screening/referral of malnutrition cases, trainings on storage of nutritious foods, and create infant flours using local ingredients coupled with interactive nutritional demonstrations. Members share their personal experiences and support each other to boost adoption of IYCF behaviors. Despite the security context, GASPAs remained active by involving community leaders in their establishment and monitoring, building social capital among women to work together and by encouraging IDPs to participate.

Results: GASPA enrolled 329 pregnant women, 422 lactating women (with children 0-6 months) and 618 pregnant women (with children 6-23 months), including 1,369 IDPs. Through collaboration with the Ministry of Health, ViMPlus conducted two successful GASPA trainings on drying and storing dark green leafy vegetables and supported GASPA in expanding screenings/referrals and interpersonal counselling. According to the SMART survey (2020-2021), GASPA activities may have contributed to improved IYCF practices in Centre Nord: exclusive breastfeeding increased from 62.9% to 86.2% and the proportion of children aged 6-23 months consuming 4+ food groups rose from 24.3% to 28.7%. In addition, global acute malnutrition in children under five decreased from 9.5% to 8.2% and the prevalence of underweight decreased from 20.6% to 17.5%.

Conclusions: Because GASPA garner social support among members, lead all community activities and have the support of community leaders and stakeholders, they are able to function effectively during times of crisis while improving IYCF behaviors. By encouraging the inclusion of IDPs, ViMPlus was able to address the needs of IDPs while reinforcing social cohesion between displaced and host communities. Lessons learned from the GASPA approach can guide effective community mobilization approaches promoted in similar contexts.

Keyword: IYCF, shock-responsive, nutrition, social support, resilience

PAB(T9-26)
Transforming Nutrition in West Africa – New Knowledge for Policy and Programme Actions

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Background and objectives: Political commitment to addressing West Africa's high rates of maternal and child malnutrition is growing. The implementation of appropriate policies and programs at scale is however hampered by limited access and use of relevant nutrition knowledge. The *Transform Nutrition West Africa project* aimed to support effective nutrition policy making and program development through an inclusive and collaborative process of knowledge generation and mobilization.

Methods: The project's activities included i) knowledge generation and evidence synthesis, ii) knowledge mobilization, and iii) stakeholder engagement and leadership capacity strengthening. We assessed and analyzed nutrition-relevant data, programs, and policies for improving maternal, infant and young child nutrition (MIYCN). The analyses used a framework called the "5PD Cycle" (Problem, Policy, Program, People, Priorities, and Data and knowledge). Secondary data analysis, evidence synthesis, mixed-methods analysis, qualitative analysis, and policy/program reviews to identify emerging issues for the region were conducted (supply-driven approach). Ongoing engagement with stakeholders ensured local priorities were addressed (demand-driven approach), while leadership capacity strengthening ensured the knowledge generated was useful and used.

Results: The project informed regional priorities through various outputs over a 4-year period, including 117 knowledge products designed for decision-makers. We established 7 strategic institutional partnerships and 12 long-term engagements at the country and regional level. We reached West African decision-makers (n=400) through webinars (n=3) and regional events (n=3) that focused on key priorities for nutrition policy and programming, through newsletters (n=10) that synthesized nutrition-relevant evidence, and presentations on project results (n=63). We also ran 4 short courses for West African nutrition professionals (n=112).

Conclusions: Project activities helped build a network of decision makers, nutrition professionals, researchers, implementers and funders in the West African region. Its success provides indirect evidence that better, contextual knowledge and capacity to use and act on knowledge is potentially a limiting factor for better nutrition policies. It is too early to assess if this project actually led to improved policies and better nutrition outcomes. Finally, the return on investment for this project might have been larger with a longer project time-frame.

Keyword: West Africa, knowledge generation and mobilization, nutrition policy and programming, leadership

Conflict of Interest Disclosure: None

Further Collaborators: TNWA team: Ampa Diatta, Mariama Toure, Loty Diop, Dieynab Diatta, Leah Salm, Mara Van Den Bold, Elodie Becquey, Johann Jerling, Nick Nisbett, Lucy Billings, Samantha Reddin

PAB(T9-27)
Assessment of the Contribution of the First Philippine Food Banking System to the Dietary Diversity of Enrolled Preschool Children in Taguig City and Bacolod City

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Background and Objective: The latest Philippine National Nutrition Survey reported suboptimal dietary diversity among pre-school children. If left unaddressed, this could contribute to high levels of stunting and underweight and the development of health conditions which may hinder Filipino children from reaching their full growth and development potential. This study aimed to assess the contribution of the first food banking system in the Philippines to the dietary diversity of the daycare beneficiaries in two pilot cities.

Methods: Cross-sectional surveys at baseline and at the end-line of feeding (after 90 days) were deployed. The food intake of the 291 daycare beneficiaries were captured through two, non-consecutive 24-hour food recalls conducted at baseline and at the end-line. The dietary diversity scores (DDS) were computed based on the Guidelines on Measuring for Household and Individual Dietary Diversity developed by FAO and was adapted from the FANTA Household Dietary Diversity Score Indicator Guide.

Results: The overall mean DDS of the daycare beneficiaries of the food banking system was 3.77 (± 0.89, 95% CI: 3.67-3.87) at baseline and 3.81 (± 0.95, 95% CI: 3.70-3.92) at the end-line. At baseline, 83.56% of the daycare beneficiaries had low dietary diversity, while at the end-line, the proportion was 79.79%. The baseline and the end-line dietary diversity score of the daycare beneficiaries from Taguig City were almost similar at 3.69 (95% CI: 3.56-3.82) and 3.76 (95% CI: 3.55-3.79), respectively. An increase in the proportion of daycare beneficiaries with inadequate dietary diversity was observed [from 85.00% at baseline (95% CI: 80.05-89.95) to 88.11% at the end-line (95% CI: 83.44-92.77)], however, it was not statistically significant. For the Bacolod daycare beneficiaries, the mean DDS increased from 3.93 (95% CI: 3.78-4.08) to 4.06 (95% CI: 3.86-4.26), and a statistically significant decrease (p=0.004) in the proportion of daycare beneficiaries with inadequate dietary diversity was observed [from 82.57% (95% CI: 75.45-89.69) to 66.04% (95% CI: 57.02-75.05)].<Conclusion:The food banking system minimally contributed (1.06% score increase) to the dietary diversity of the daycare beneficiaries. Provision of whole, fresh food, more food recalls, and accounting for seasonal variations through extended observation are recommended moving forward

Keyword: food bank, dietary supplementation, pre-school children, dietary diversity, Philippines

Conflict of Interest Disclosure: This study was funded by the Philippine Council for Industry, Energy and Emerging Technology Research and Development, Department of Science and Technology.None

Further Collaborators: Mr. Jomar B. Fleras (Rise Against Hunger Philippines). Ms. Arlene C. Castro (Rise Against Hunger Philippines

PAB(T9-28)
New Metrics and Assessment Tools to Support Innovative Financing of Nutritious Foods

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Background and Objective: Small- and medium-sized enterprises (SMEs), major contributors to the food sector, could play a key role in expanding access to nutritious foods in low- and middle-income countries. However, they often lack financing. Impact investment can help fill this need, but doing so effectively requires properly targeting firms that are likely to have an impact on nutrition – and on understanding this potential impact. We thus sought to define metrics for targeting and assessing nutrition-sensitive impact investment.

Methods: Based on a theory of change for how such investments could impact healthy diets, we determined a need for: clear, useable definitions of nutritious foods; prioritisation of firm types; prioritisation of consumers; and simple metrics for capturing outcomes. We undertook a review of available metrics used in impact investment, as well as within nutrition, and considered their feasibility and applicability to practical application by non-specialists in low-income settings.

Results: An actionable definition of nutritious foods can be applied to target SMEs but requires some simplification in order to make it applicable in a context of limited information and limited nutrition-specific expertise. Considering contextual factors is harder but can be accomplished at a basic level through simple multiple choice screening factors. Confidence in likely nutrition contribution is higher, and assessment of effects at the consumer level is easier, when considering value-chain segments closest to consumers (e.g., processors, retailers). To increase potential impact and minimize risk, however, it is also useful to include firms that are more distal (e.g., transporters, cold storage providers). Assessing consumer-level impact is challenging and may be impractical for most nutritious food financing investments; options exist for surmounting these challenges, but tracking indicators more proximate to

investments (i.e., outputs) is likely to be more feasible – and potentially sufficient in many cases.

Conclusions: Impact investment has considerable untapped promise for nutrition, and targeting such investments to maximize potential nutrition impact is feasible. However, it requires adapting—and simplifying—approaches and definitions usually used in the nutrition field. Applying such metrics, impact investment could be used to spur greater access to safe and nutritious food for all.

Keyword: financing, nutritious foods, investment, SMEs, business

Conflict of Interest Disclosure: None

Further Collaborators: We acknowledge the contributions of Sofia Condes and Djeinam Toure during the early stages of this work

PAB(T9-29)
A case for sub-national investment into nutrition in Kenyan counties

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Background and objectives: By 2030, undernutrition will cost Kenya US$ 38.3 billion in GDP losses due to loss of workforce productivity. In 2018, multi-sectoral County Nutrition Action Plans (CNAPs) were developed to target undernutrition at the county level. This paper assesses the potential health impacts and economic benefits of scaling up the high-impact nutrition interventions in the CNAPs for five counties – Nandi, Busia, Makueni, Vihiga, and Elgeyo Marakwet.

Methods: The Cost of Hunger in Africa methodology was adapted to calculate undernutrition-related costs to health, education, and productivity sectors for one year. CNAP costing data were categorized into high-impact, nutrition-sensitive, enabling environment, and other public health interventions. Then, the Optima Nutrition tool was used to project the health impact of high-impact interventions from 2018 to 2022. The results were converted to DALYs to conduct benefit-cost analyses and cost-effectiveness analyses.

Results: The Cost of Hunger in undernutrition was nearly 1% of the GCP of the respective counties (USD $2-$5 million). The total CNAP budget ranged from USD$12-22 million, and high-impact interventions made up 35% of the total budget. Between 2018 and 2022, the five CNAPs aimed to reach 1.67 million children, 900,000 adolescent girls in schools, and 330,000 pregnant women. Vitamin A Supplementation programs for children 6-59 months, in-school weekly iron and folic acid supplementation programs for adolescent girls, and iron and folic acid supplementation programs for pregnant women had the highest reach. In total, high-impact interventions could avert 1800 child and 115 maternal deaths, prevent and treat 19,000 cases of stunting and 4700 cases of wasting in children under 5 and mitigate 67,000 cases of anemia in pregnant women and adolescent girls. County-level benefit-cost ratios ($5:1 to $14:1) and cost per DALY averted values hint at highly cost-effective interventions, though the cost per case averted values vary significantly.

Conclusions: CNAPs were the first set of plans to budget for nutrition interventions at the sub-national level. The results were used to lobby for increased investment in nutrition at the county level. Future analyses should consider a targeted sub-national approach for a higher return on investment.

Keyword: High-impact nutrition interventions, Sub-national analysis, Return on Investment, Cost-benefit analysis, Kenya

Conflict of Interest Disclosure: None

PAB(T9-30)
In pursuit of understanding dietary intake: how FAO/WHO Global Individual Food consumption data Tool (FAO-WHO GIFT) is changing the way we use and visualize dietary data.

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1. Food and Agriculture Organization of the United Nations (Italy), 2. Istituto Nazionale di Statistica (Italy)

Background and objectives: Dietary surveys are a source of highly valuable information on what individuals eat and drink. They allow us to assess whether observed diets provide adequate nutrition and identify dietary practices that may increase the risk of non-communicable diseases. They also help to inform us about determinants of dietary intakes, such as food availability, accessibility, behaviors and customs. This knowledge is crucial for the global community to respond to the dietary transformation and promote healthy diets. High quality dietary data can be expensive and time consuming to collect, and is consequently lacking in many countries, especially low and middle income countries (LMICS). Where dietary data exists, it is often difficult to access, and is not harmonized, which hinders analysis and use. FAO, with the support of WHO and other international partners, created the FAO/WHO Global Individual Food consumption data Tool (FAO/WHO GIFT) to facilitate sharing of harmonized datasets of individual quantitative food consumption data as freely available microdata and summary statistics.

Methods: Three hundred and two potentially suitable dietary surveys were identified based on work with partner initiatives, and through a dietary data network. Data owners were approached and asked for permission to share their data publicly. All eligible datasets were harmonized and coded with the FoodEx2 food classification and description system.

Results: The platform currently includes 34 datasets and continues to grow. Robust algorithms are applied by standard

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DOI: 10.1159/000530786

automatic procedures to calculate summary statistics and display them on interactive dashboards tailored for non-expert users. The platform offers indicators which provide information about the composition of the diet, quantitative information on the micro and macronutrient intakes and sources in the diet, and daily portion sizes of selected foods and food groups to support food safety risks assessment. New innovative indicators on the environmental impact of the diet and estimated usual intakes of nutrients are currently being added to the platform.

Conclusions: Harmonizing and sharing dietary data and presenting it in the form of easy-to-understand summary statistics increases the number of stakeholders who may use it to inform programs and policies for nutrition.

Keyword: dietary data, open data sharing, data harmonization, indicators

PAB(T9-31)

A synopsis of the policy and funding modalities of school food programs operating in the G7 countries

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1. University of Saskatchewan (Canada)

Background and objectives: The school food landscape is broad, and policies underlying the school food programs (SFPs) are often very complex. Purpose of this paper is to review the national policy and funding modalities underlying the school food programs in the G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) to help identify best practices, and their applicability in Canadian context.

Methods: National ministerial websites commonly responsible for school food programs were searched for school food policy and programs. Scientific literature, reports, grey literature published in English after 2000 were reviewed. Webinar with academicians, researchers and practitioners from Japan, United States (US), Italy, Germany and France were held to accumulate information otherwise scarcely available online.

Results: Focus of school food policies varied significantly across the G7 countries. While food education was at the core of SFPs in Japan, reducing negative impact of food production on climate change and biodiversity was key in the strategies formulated in Germany. A broad level influence of EU policies on the production and consumption of organic food was found on the school food programs in Germany, Italy, and France. In most of these countries, co-payment system was found where federal/provincial/municipalities funds through agricultural subsidies and parents contribute by paying ingredients and labour cost. Significant regional variation was found within these countries in program participation rate, school meal price as well as in enacting state-level school food policies resulting in a complex web of policy and program modalities. Multisectoral collaboration was found to be key for the success of these programs.

Conclusions: Our research gives a picture of the policy and legislative landscape of the school food programs in the G7 countries. Our findings will help the G7 countries to learn from one another and incorporate the best practices going forward.

Keyword: School food policy, school food programs, Funding, G7 countries

Conflict of Interest Disclosure: None

PAB(T9-32)

The utility of global open-source databases for food system decision-making in low-income settings

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Background and objectives: The school food landscape is broad, and policies underlying the school food programs (SFPs) are often very complex. Purpose of this paper is to review the national policy and funding modalities underlying the school food programs in the G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) to help identify best practices, and their applicability in Canadian context.

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Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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Keyword: School food policy, school food programs, Funding, G7 countries

Conflict of Interest Disclosure: None

PAB(T9-33)
Contribution of traditional food systems to food and nutrition security status of rural households in low-income communities

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Background and objectives: The climate change induced shocks and stressors have created poverty traps and increased the prevalence of food insecurity and malnutrition, especially in low-income communities. One of the adaptation strategies adopted include the increased reliance on traditional food systems, i.e., indigenous fruits and vegetables and wild harvested edible insects for household food and nutrition security. However, the potential contribution of traditional food system to food and nutrition security has not been fully researched resulting in lack of evidence to promote the inclusion of traditional foods in the programming of food and nutrition security interventions. In Zimbabwe there are limited scientific studies on the consumption and contribution of indigenous fruits and vegetables and edible insects to food and nutrition security. This study investigated the association between consumption of wild harvested edible insects, indigenous fruits and vegetables with nutrition outcomes such as minimum dietary diversity, women dietary diversity, food-consumption score, and coping strategy index.

Methods: Secondary data generated from 11,973 households during a nationwide livelihoods assessment survey conducted in 2020 was used. Paired sample t-test, Chi-square, and Pearson's correlation coefficient were calculated to determine the mean distribution differences, and correlations between nutrition outcomes consumption of wild harvested edible insects, indigenous fruits, and vegetables.

Results: The results revealed that at least 14 wild harvested edible insect species, 26 indigenous fruits and 10 indigenous vegetables are commonly consumed in rural Zimbabwe. The main findings are that (i) consumption of all the three (edible insects, indigenous fruits and vegetable) had a positive impact on women dietary diversity score, food-consumption score and coping strategy index, (ii) consumption of wild harvested edible insects had a positive impact on minimum acceptable diet, and (iii) consumption of indigenous vegetables had a positive impact on minimum meal frequency.

Conclusions: This study provides important evidence to the thematic area of traditional food systems and their contribution to food and nutrition security, which has received little attention from researchers and policy makers. Findings from this study are key for advocacy and programming of food and nutrition security and resilience building intervention programmes.

Keyword: Traditional food systems, Nutrition, Food and nutrition security, Indigenous foods, Livelihoods

Conflict of Interest Disclosure: None

Further Collaborators: None

PAB(T9-34)
An optimization model for evaluating the food intake for meeting the nutrient requirements for the ICDS-SNP provisions with the optimal cost

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Background: The nutritional status of young Indian children continues to be sub-optimal despite decades of programmatic interventions. The prevalence of stunting and wasting in < 5y old children are relatively stagnant at 35.5% and 19.3%, respectively, according to the latest National Family Health Survey (NFHS)-5. The critical period during which growth faltering occurs, starts from weaning, at 6 months of age, and continues up to 2-3 years of age, resulting in an increase in stunting prevalence with age, and this is borne out by the NFHS and other national surveys. This occurs despite the Supplementary Nutrition Program of the Integrated Children Development Service (ICDS-SNP) of the Indian Government. Since this program requires inputs to provide the best possible nutrition in different geographic and social circumstances, we created a nutrient optimisation model for the ICDS-SNP, which could recommend the quantities of selected raw foods to meet child nutrient requirements with a cost ceiling.

Methods: A linear programming optimization technique was used to derive the required quantities of different raw food items to meet the ICDS-SNP targets. The objective was to minimize total cost incurred, subject to the constraints of meeting the nutrient requirements and the fund allocation set by the ICDS-SNP. Additionally, user specific and nutrition expert-advised constraints were also considered. Since program delivery is operationally different for 1-3 and 3-6y old children in this age band, we considered separate optimizations for these ages.

Results: The model computed the required quantity of selected raw foods to be consumed by beneficiaries to meet the

ICDS-SNP mandated daily nutrient requirements of 500 kcal energy and 12-15g protein. These optimized solutions also met the requirements of selected micronutrients at 30% of their Recommended Dietary Allowances (RDA), within allocated cost constraints. We also created an interactive user-app for this purpose for use by stakeholders involved in the ICDS-SNP, as well as a separate interactive app for public use, hosted at https://icdslive.herokuapp.com.

Conclusions: By using the present model, it is possible to run an optimal and feasible ICDS-SNP that meets nutrition goals, and which can go a long way in improving the nutritional status of Indian children.

Keyword: Optimization Tool, ICDS-SNP, Cost Minimization

PAB(T9-35)
A report on the transition and current status of the school lunch system in Japan - Possibility of school lunch -

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Background and objectives: In Japanese school lunches, menus are provided that not only promote Japanese cuisine but also promote understanding of other countries' culinary cultures. This report reports on the current school lunch system.

Methods: author investigated how school lunches have changed from the history to the present by examining various themes of literature and school lunch menus.

Results: The current school lunch system makes it possible to create menus that allow students to understand the cultures of other countries.

Conclusions: The Japanese school lunch system, which can provide a variety of menus, is a teaching material for "multicultural coexistence" that fosters understanding of other countries.

Keyword: multiculturalism, school lunch, nutrition education, public policy

PAB(T9-36)
Improving Nutritional Outcomes by Responding to Pandemics Through an Epidemiologically- Smart Social Protection Framework

Ana Solorzano[1]*, Michael Smith*[1]*, Juan Gonzalo Jaramilo Mejia*[1]*, Adhvik Shetty*[1]*, Manucheher Shafee*[1]

1. World Food Programme (Italy)

Background and objectives: There are 6.4 million deaths attributed to COVID-19 (WHO, 2022). However, COVID-19 is not the only global pandemic. Nearly 40 million people worldwide are living with HIV, with 1.5 million new infections in 2021. All while global outbreaks of tuberculosis, cholera, and influenza remain (UNAIDS, 2021). Furthermore, the incidence of Monkeypox is steadily increasing across the globe as a future pandemic.

Malnutrition is a catalyst for pandemics. Poor quality food exacerbated the spread of the Spanish flu while obesity increased the severity of COVID-19 ((Martini et al., 2019; Chu et al., 2020). Malnutrition also inhibits antigen responses and can lead to Nutritionally Acquired Immune Deficiency Syndromes (NAIDS) (Beisel, 1996). At the same time, pandemics like HIV can decrease the availability of and access to nutritious foods while increasing health expenditure (Weisar et al., 2007). Malnutrition and pandemics, therefore, exist in a vicious cycle.

Social protection can improve nutrition to disrupt this vicious cycle through its effects on prices, incomes, behaviours, assets, agency, and services. These modes of impact influence the underlying outcomes of diet quality and quantity, feeding and care practices, food environments, educational attainment, and gender equity. Together, these impacts can improve health outcomes and resilience to disease.

However, while these impact pathways appear axiomatic, little systematic research demonstrates how social protection responses can address nutritional outcomes in the face of pandemics.

This article addresses this gap and explains how social protection is a policy instrument of choice during pandemics to improve nutritional outcomes.

Methods: The article reviews literature in nutrition, epidemiology, and social protection to build an evidence-based analytical framework. This framework consists of five building blocks which rely upon a continuum of care model which looks at prevention, testing, treatment, adherence, and recovery in the context of a public health crisis.

Results: The article finds that the health and nutrition sectors have not fully explored how social protection can support the nutritional prevention, mitigation, and recovery from pandemics.

Conclusions: This blind spot leaves nations nutritionally vulnerable to future pandemics. The introduced epidemiologically smart framework represents a novel effort to bridge nutrition and social protection.

Keyword: Nutrition, Social protection, Pandemics, Disease

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-37)
Mind the Gap: Evidence from Countries Across the World on Nutrition and Social Protection

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1. World Food Programme (Italy)

Background and objectives: Sustainable Development Goal Target 2.2 aims to end all forms of malnutrition by 2030. Access to and choice of nutritious foods are key determinants to meeting this target. The World Food Programme, along with partners, developed the Fill the Nutrient Gap (FNG) tool to highlight the risk of nutrient gaps and identify disenabling factors affecting nutritionally vulnerable groups. This tool estimates the cost and affordability of nutrient-adequate diets, supplemented by a review of the food supply chain and the environment, dietary practices, and nutrition situation. The FNG assesses the extent to which people can make the choice to purchase nutritious foods and seeks to understand these choices, recognizing that sustainable healthy diets must provide adequate nutrition. Additionally, the FNG models how interventions across sectors, including social protection, can contribute to making nutritious diets more affordable.

Building upon this work and the understanding that adequately designed social protection systems can improve nutrition outcomes, this publication highlights how the FNG analysis did or could inform nutrition-sensitive social protection systems and the effects of these systems on nutritious diets for households in fourteen countries.

Methods: Methodologically, the publication will provide an overview of the malnutrition burden, demonstrate its effects on human capital formation, provide a brief description of the integration of nutrition and social protection in national policy frameworks, and highlight existing challenges to nutrition-sensitive social protection. Next, the article will present an overview of the FNG analysis on the cost and affordability of a nutritious diet and highlight the modelled potential contribution of social protection in bringing healthy, nutritious diets more within reach.

Results: The synthesis found that malnutrition in all its forms continues to affect countries across the world, leading to substantial losses in human capital and economic growth. The case studies find that adolescent girls and pregnant and lactating women are particularly nutritionally vulnerable and face higher costs to meet their nutrient needs. <

Conclusions: The FNG analysis provided useful insights on how to make social protection more nutrition-sensitive, which have the potential to inform the integration of nutrition objectives into social protection programmes. >

Keyword: Nutritious Diets, Social Protection, Food Systems

PAB(T9-38)
Impact of Biofortified Foods and Food Products

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Background and objectives: Biofortification is the process of increasing the concentrations and/or bioavailability of micronutrients in staple crops and has the potential to mitigate micronutrient deficiencies globally. Efficacy trials have demonstrated benefits of consuming biofortified crops; here, we sought to understand the research gaps, implementation barriers and potential solutions to increase the impact and scale up of biofortification.

Methods: We synthesized the evidence on biofortified crops across the domains of bioaccessibility and bioavailability; micronutrient retention; sensory acceptability; factors influencing adoption; efficacy trials; and effectiveness of biofortified food consumption on micronutrient status. For the latter (effectiveness), we considered different impact pathways including via direct purchase, informal and formal supply chains, and own production.

Results: For each domain, we found: 67 studies (bioaccessibility and/or bioavailability; 50 studies (micronutrient retention); 53 studies (acceptability); 42 studies (adoption); 16 trials (efficacy); and 25 studies (effectiveness). The baseline levels of micronutrient and cultivar/genotype were most impactful on bioaccessibility, bioavailability and micronutrient retention after post-harvest processing. Biofortified crops met sensory acceptability thresholds in most preparations and populations, and facilitators or barriers to adoption depended on crop and setting. Results from efficacy trials suggest that iron and provitamin-A biofortified crops improve some biomarkers of micronutrient status in the randomized control trials conducted to date. Results from effectiveness studies suggest an improvement in micronutrient status via consumption of biofortified crops from farmers' own production, mainly as provitamin A from orange sweet potato, in controlled interventions that involved the creation of demand, the extension of agriculture and promotion of marketing.

Conclusions: In summary, evidence supports that overall, biofortified crops are bioaccessible and bioavailable, retain micronutrients well, are sensorily acceptable, and can be part of food systems interventions to reduce micronutrient deficiencies in farmer households. Several gaps remain including understudied crops, populations, processing/preparation styles, and real-world effectiveness amongst urban consumers and in formal or informal settings. Ongoing and future research will help fully inform strategies to increase the impact and scale up of biofortified foods and food products.

Keyword: Biofortification, Micronutrients, Impact, Agriculture, Bioavailability

Conflict of Interest Disclosure: SM is an unpaid board member for and has an equity stake in a diagnostic start up focused on developing point-of-care assays for nutritional status informed by his research as a faculty member at Cornell University. All other authors have no conflicts of interest. GAIN is a not-for-profit organization supporting and promoting biofortification programs; V.M.F., M.N.N.M., E.M. and A.M.N. are employees of GAIN. All other authors declare that they have no known conflicts of interest.

PAB(T9-39)
Changes in the use of low-calorie sweeteners in packaged foods and beverages launched in the Brazilian food supply in the last 20 years

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Background and objectives: The use of low-calorie sweeteners (LCS) by industry in foods and beverages has increased in several countries. This increase may be even more accentuated as a response to the implementation of public policies to reduce added sugars. Because the effects of LCS consumption are still inconsistent, we aimed to assess changes in the use and types of LCS over time (2001-2021) in packaged foods and beverages launched in Brazil.

Methods: We used commercial data from 118,861 packaged foods and beverages provided by the Mintel Global New Products Database. We identified foods and beverages with LCS using the list of ingredients. We assessed changes in the prevalence of foods and beverages with artificial or natural nonnutritive sweeteners (NNS) and sugar alcohols that were launched in Brazil over a 20-year period, overall and by food category.

Results: The prevalence of foods and beverages with LCS launched in Brazil went from 8.9% (n=51) in 2001, to 10.9% (n=936) in 2021. Over a 20-year period, the most prevalent type of LCS in products shifted, with the use of artificial NNS becoming less prevalent over time (from 7.0% to 5.3%), while the prevalence of sugar alcohol increased (from 4.0% to 5.7%), as did the prevalence of natural NNS (from 1.4% to 6.3%). In 2001, non-carbonated sweetened beverages, candies, cakes and sweet pies were the products with the highest prevalence of LCS use, while carbonated and non-carbonated sweetened beverages and dairy beverages had the higher prevalence in 2021.

Conclusion: The prevalence of foods and beverages with LCS in the Brazilian food supply increased from 8.9% to 10.9% over a 20-year period and was accompanied by an increase in natural NNS e sugar alcohols use. Because of the unclear evidence that links LCS to better health outcomes, monitoring the prevalence of LCS is critical, particularly in countries with strategies that can lead to increases in LCS use, such as Brazil. In addition, clearer front-of-package information regarding the presence of LCS can help consumers make more informed choices.

Keyword: Low-calorie sweeteners, Food additives, Nutritional labeling, Public policies, Public health

Conflict of Interest Disclosure: None

Further Collaborators: None.

PAB(T9-40)
High sugar and salt levels in commercial Food Products for Infants and Young Children in Malaysia: results from a pilot study using the World Health Organization Nutrient and Promotion Profile Model

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Background and objectives: The first 1000 days of life are critical in determining a child's growth, development, and future health risks. Hence, commercially available unhealthy food products for infants (up to 12 months) and young children (12-36 months) (FIYC) introduced in this critical period are a public health concern. Thus, the WHO proposed a Nutrient and Promotion Profile Model (NPPM) to evaluate these products according to nutritional and promotional criteria. Several European countries reported FIYC had high sugar and sodium content and employed inappropriate promotional strategies. Malaysia, a rapidly developing economy, has an extensive availability of commercial FIYC. Given the rapid increase in obesity and diabetes in the population, it is important to evaluate the FIYC sold in Malaysia.

Methods: We evaluated the nutrient profiles and promotional strategies of FIYC (n= 285) available in Kuala Lumpur using the WHO draft NPPM. We included (i) dry powdered and instant cereal/ starchy food (n=88), (ii) Soft wet spoonable, ready-to-eat-foods (n=60), (iii) Meals with chunky pieces (n=2), (iv) Snacks (n=130), and (v) Drinks (n= 5).

Results: Overall, only 27% of the products satisfied all nutrition criteria (Individual criterion satisfied (% products): sugar: 51%, salt 58%, energy density: 21%, protein: 91% and fat: 95%). Moreover, only 23% of the products met all relevant proposed NPPM promotional requirements. Only 62% of the products included a message emphasising the importance of breastfeeding while 92% of the products had inappropriate nutrition or health claims.

Conclusion: There is an urgent need to create awareness and dialogue among all stakeholders including baby food manufacturers and importers, the Malaysian Ministry of Health,

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

healthcare professionals, parents, and caregivers towards improving the quality of FIYC available in Malaysia.

Keyword: Infant and young children, Complementary foods, Nutrient Profile and Promotion Model, Infant nutrition, Food policy

Conflict of Interest Disclosure: Prof Janet Cade is the director of Dietary Assessment Limited. The other authors have no conflicts to declare.

PAB(T9-41)
Acceptability of multiple micronutrient-fortified bouillon cubes among women in 2 districts in the Northern region of Ghana

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Background and objectives: Bouillon is a promising fortification vehicle in West Africa because it is widely consumed. We evaluated the acceptability of two different multiple micronutrient-fortified bouillon cube formulations, compared to cubes with iodine only.

Methods: We conducted a double-blind randomized controlled study in the Tolon (2 urban, 1 rural cluster) and Kumbungu (1 urban, 1 rural cluster) districts of the Northern region of Ghana (n = 84 women). Two formulations of multiple micronutrient-fortified bouillon cubes containing iron, zinc, folic acid, vitamins A and B12, and iodine at "upper" (45 - 125% of CODEX) or "lower" (15-50% of CODEX) concentrations, and a control cube that contained iodine only (50% of CODEX) were evaluated. Cubes were prepared specifically for this trial and similar to cubes commercially available locally. Baseline data included household composition and information on bouillon use. Women then participated in 2 days of center-based sensory testing (acceptance, preference, discrimination); using a randomized crossover design, women evaluated all three formulations as both raw cubes and cubes prepared in two common dishes (okra soup and jollof rice). Women were then randomized to receive a household ration of a single bouillon formulation to use in household cooking for a 14-day period. For acceptance testing, cubes and dishes (both center-based and household-prepared) were rated on a 5-point Likert scale (1 = dislike very much, 5 = like very much).

Results: Almost all (92.9%) participants reported bouillon use at least twice per day. Mean overall liking of the three raw cubes ranged from 4.3 – 4.5 on the 5-point Likert scale (p = 0.17). There were no differences in the liking of appearance, feel, aroma, or taste among the cubes, although one of the cubes was rated lower for crumble compared to the other cubes (85% vs. ≧ 94%; p = 0.03). There were no differences in overall liking or specific attributes (appearance, color, taste, aftertaste, saltiness) among the 3 cubes when they were used in the 2 dishes or household recipes.

Conclusions: All three cubes were well-liked by respondents, suggesting that any of the 3 cubes would be acceptable for use in future research.

Keyword: Acceptability, Fortification, Bouillon cubes, Micronutrient deficiencies

Further Collaborators: Marjorie Haskell

PAB(T9-42)
Neural tube defects in Ghana, current trends and relevant strategies for policy actions

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Background and objectives: Neural tube defects (NTDs) are among the commonest congenital malformation affecting over 300,000 births globally each year. NTDs are one of the health consequences of Folate (Vitamin B_9) deficiency. NTDs are prevalent globally but there is little documentation on them. In Ghana, the NTD prevalence of 1.15/1000 births (in 1993 for KorleBu Teaching Hospital) and 1.6/1000 births (in 2017 for Tamale Teaching Hospital) have been reported. This study assessed the current trends of neural tube defects in Ghana.

Methods: Data were sourced from the District Health Information Management System (DHIMS2) of the Ghana Health Service, google scholar and PubMed searches as well as key-informant interviews. The ANOVA test was used to assess differences in NTD cases across the regions over 5 years period.

Results: The National NTD were 430, 441, 468, 483, and 420 cases between 2017 to 2021. There were no significant differences in the number of cases over the years (p-value = 0.976). However, there were significant (p-value < 0.001) regional disparities with the highest cases found in Ashanti, Greater Accra, Eastern and Central Regions. Savannah Region recorded the least cases. There is ongoing iron and folate supplementation for adolescent girls and pregnant women in Ghana. However, there is no direct surveillance targeting folic acid deficiency and its associated birth defects.

Conclusions: The current National prevalence NTDs is unknown/unreported. The prevalence of NTDs has not reduced over the years and this is an issue of public health concern. These NTD cases are likely under-reported in hospitals where the data was taken due to stigma and ignorance. There is a need for targeted surveillance by including folate assessment in the periodic surveillance by the Ghana Demographic Health Survey and research focusing on alternative economical assessment

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

techniques as well as the extent of folate fortification of cereals and staples.

Keyword: Folate deficiency, Folic acid, Birth defects, Neural tube defects, Vitamin B9

Conflict of Interest Disclosure: None

Further Collaborators: Richard Stephen Ansong, Department of Nutrition and Food Science, University of Ghana, Legon, Accra

PAB(T9-43)
Assessing the transition of Vitamin A supplementation to routine delivery in Côte d'Ivoire

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1. Helen Keller International (Cote d'Ivoire), 2. Programme National de Nutrition (Cote d'Ivoire)

Background and objectives: Transitioning vitamin A supplementation (VAS) from a campaign model to delivery through the routine health system is a priority to ensure sustainable coverage, and was started by the government of Côte d'Ivoire in 2016. To date, only 41 of 113 districts are in routine delivery and facility-based coverage remains low. The aim of this research was to (i) assess routine delivery and (ii) identify barriers related to the transition with the aim of developing corrective strategies.

Methods: Following the Consolidated Framework for Implementation Research CFIR), the study identified five domains of the health delivery system for assessment: (i) the characteristics of the intervention, (ii) the external framework, (iii) the internal framework, (iv) individuals involved in the implementation, (v) the process of implementation. Relevant sub-domains (n=32) and specific measures were identified. We conducted (i) quantitative surveys of 1826 households, 76 Facility Managers, 96 Health Workers, 112 Community Health Workers (CHW) and (ii) 52 qualitative interviews of regional, district, and community actors in 24 districts.

Results: We identified four major constraints to routine delivery of VAS. **First**, while health districts can estimate the number of children eligible for VAS each month, many communities' health posts do not. Without clear targets, coverage is low (35%), and often rectified by ad-hoc, costly campaigns. **Second**, 78% of facility managers reported regular stockouts. Incomplete reporting of capsules delivered results in poor stock planning, as stock is replenished based on the number of supplemented children. **Third**, caregivers are not aware of the availability of routine VAS. Community criers are the most widespread source of awareness. **Fourth**, while constructive feedback and community appreciation contribute significantly to community health workers motivation, this is insufficient to overcome their lack of remuneration and high perceived workload.

Conclusion: We identified four actions that could increase routine VAS coverage by health posts: (i) coach health post staff in monthly planning and target setting; (ii) revising and simplifying monitoring tools; (iii) train and mentor health post staff in routine, accurate record keeping; and (iv) build systems to ensure regular resupply.

Keyword: Transitioning to routine delivery, vitamin A supplementation, health system strengthening, Implementation research, Community Health Worker motivation

PAB(T9-44)
Key failure factors in Vitamin A Supplementation: Lessons from Nigeria

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Background: Vitamin A deficiency remains prevalent among children under 5 years in Nigeria and vitamin A supplementation (VAS) is organized bi-annually during Maternal, Newborn, and Child Health Week campaigns. In 2021, Helen Keller International, Nigeria, supported the implementation of two rounds of VAS campaigns in six states covering approximately 5 million children each. The aim of this research was to assess VAS coverage and identify factors affecting coverage and campaign success.

Methods: Post-event coverage surveys (PECS) were administered after the second round of VAS to determine coverage and highlight factors affecting coverage. Using the WHO population probability to size, 30 households, one community leader, and one health worker, from 30 communities each were randomly sampled and interviewed in Akwa-Ibom, Benue, and Nasarawa states (2880 persons in total). Data was collected by trained enumerators using ODK (Open Data Kit) and analyzed using thematic analysis techniques and descriptive statistics.

Results: A total of 2,433,117 children in the three states (target = 2,807,261) received VAS during the second round. Coverage in Akwa-Ibom, Benue, and Nasarawa states was 64.1%, 68.1% and 76.1%, respectively. Factors affecting coverage include (i) poor community mobilization for the MNCHW which was most frequently cited, (ii) late arrival of commodities and insufficient commodities due to inadequate health worker forecasting capacity, (iii) insecurity and communal clashes which made some communities inaccessible, (iv) disruption due to other competing interventions i.e., Covid-19 mass vaccination campaign, (v) shift from door-to-door implementation strategy (started in 2020 due to the covid-19 pandemic) back to facility-based supplementation.

Conclusion: VAS coverage was moderate and fell below the effective coverage of 80% in the 3 states assessed. Factors affecting coverage were related to the program, health system, and insecurity. Adequate community mobilization, proper

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

planning, coaching of health workers, and integration of VAS with other health activities can mitigate these factors and potentially increase coverage.

Keyword: VAS - Vitamin A Supplementation , PECS_-Post Event Coverage Survey

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PAB(T9-45)
Anemia and iron folic acid supplementation in India: recent progress and missed opportunities

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Background and objectives: Anemia prevalence in India has not decreased in the past 50 years. To address this severe public health issue, a national 'Anemia Free India' program was launched in 2018, with iron folic acid (IFA) supplementation as a core component. We sought to examine 1) recent trends in anemia prevalence and IFA coverage, 2) failure points along the IFA supply chain from delivery platform to consumption.

Methods: Data on anemia prevalence in children 6-59m, non-pregnant women 15-49y and pregnant women 15-49y were from the 2015-16 and 2019-21 rounds of India's National Family Health Survey (NFHS). NFHS follows a systematic sampling procedure and is representative down to the district level. Burden estimates were derived using 2020 population projected from 2011 Census data. Additional data from NFHS included IFA delivery platforms (antenatal care, postnatal care, childcare center, in school), IFA receipt and IFA consumption. Principal component analysis of assets was used to generate a wealth index and the sample was divided into wealth quintiles to assess inequities in IFA coverage. Monthly Health Monitoring Information System (HMIS) data from 2015 to present were used to examine IFA provision.

Results: Between 2015-16 and 2019-21, anemia prevalence remained at 50% in pregnant women and 53% in non-pregnant women but increased from 59% to 67% in children. HMIS data show increasing IFA provision at critical life stages: pregnancy (77% in 2015-16 to 91% in 2019-21), postnatal (35% to 50%), childhood (7% to 15%); adolescence (23% to 39%). IFA provision dropped sharply during the COVID-19 pandemic but recovered to pre-pandemic levels within 2-3 months for pregnant women; recovery was slower for children and adolescents. Though HMIS data show that 91% of pregnant women were provided 180 IFA in 2019-21, NFHS data from the same period show that only 26% of women consumed 180 IFA during their pregnancy. A pro-rich gradient was observed from platform to receipt to consumption.

Conclusions: A recent increase in IFA provision and consumption may indicate early success of the 'Anemia Free India' program. Further programmatic efforts are needed to reach children and adolescents and to increase compliance, especially among the poor

Keyword: anemia, iron folic acid, implementation science, women, children

Conflict of Interest Disclosure: None

PAB(T9-46)
Digital monitoring of anemia control measures in a district using Anemia Mukt Bharat Health Management Information System indicators

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Background and objectives: Anemia is a severe public health problem in India affecting more than fifty percent individuals across most age groups. Anemia Mukt Bharat (AMB) programme, with target of 3-point reduction in anemia prevalence per year, developed a monitoring mechanism based on a set of 18 indicators and 6 key performance indicators (KPIs) derived from routine reporting in Health Management Information System (HMIS). Objective of the study was to assess status of anemia control measures in district Faridabad, Haryana using AMB HMIS indicators for the period of April 2018 – March 2019.

Methods: A cross sectional study was conducted in district Faridabad, Haryana from May 1 to June 15, 2019 (Reference period - April 2018 – March 2019). Status of existing activities for anemia control was assessed by documentation of HMIS indicators identified by AMB programme to be used for routine monitoring. Sources of data were HMIS, programme reports and district annual reports. Denominators provided by AMB programme were used for ascertaining proportions. Critical review of the generated data was done along with description of collection and reporting process.

Results: Activities in place to control anemia were prophylactic iron and folic acid (IFA) supplementation and deworming to 6 – 59 months children, adolescents, and pregnant and lactating women. For children 5 – 9 years of age, IFA was not provided in the district but deworming was done. Coverage of IFA prophylaxis in children 6 – 59 months was 22.5%, in adolescents was 50.7 %. The 180 days IFA supplementation in pregnant women was 33.8 %. IFA stock status was not being captured in the district. AMB index for district Faridabad (April 2018 – March 2019) was 26.8. Gaps in understanding of data elements, and mismatch between AMB denominator data and census forecasts limited the data accuracy.

Conclusions: Overall, the status of anemia control measures as assessed by HMIS indicators was not satisfactory in the study district. Number based reporting and issues with data quality limited the use of data for decision making. Periodic evaluations

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

of anemia control measures at district level maybe required to achieve the targets set by Anemia Mukt Bharat programme.

Keyword: Anemia, Anemia Mukt Bharat, Health Management Information System

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PAB(T9-47)
Assessment of free sugar, added salt, fortification levels and selected labelling practices of commercially produced complementary foods sold in Cambodia and Indonesia

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Background and objectives: Global guidance on the appropriate composition, fortification and labelling of commercially produced complementary foods (CPCF) exist to assist countries in determining if available CPCF are suitable for older infants and young children, do not interfere with breastfeeding, and are unlikely to contribute to overweight and non-communicable diseases. This study assessed the presence of free sugar and added salt, the appropriateness of fortification levels, and selected labelling practices of CPCF marketed in Cambodia and Indonesia against Codex Alimentarius and WHO standards and guidance.

Methods: CPCF products were purchased in Khsach Kandal, Cambodia (n=68) and Bandung City, Indonesia (n=211). Using product label information, this cross-sectional study assessed the presence of free sugars, added salt, calcium, zinc and iron fortification levels, age of introduction, and daily ration recommendations against Codex Alimentarius (Codex) and WHO standards and guidance.

Results: This study found that in Cambodia almost all (90%) and in Indonesia nearly three quarters (74.3%) of CPCF products listed free sugars in the ingredient list. All puddings and cereal-based snacks in Indonesia, and all yoghurts and 94.6% of cereal-based snacks in Cambodia contained free sugars. Eighty percent of Indonesian and 100% of Cambodian cereal-based snacks contained added salt. Of products fortified with calcium, zinc, or iron, 44.6% 12.1% and 65.8% in Indonesia and 5.0%, 0% and 32.1% in Cambodia, respectively, provided the Codex recommended minimum of 50% RNI per daily ration. Seventeen percent of Indonesian and 5.8% of Cambodia products failed to provide an age of introduction greater than or equal to 6 months and few provided a daily ration (38.4% in Indonesia and 11.8% in Cambodia).

Conclusion: None of the products assessed complied with the Codex Alimentarius and WHO standards and guidance against which they were assessed, thereby falling short of the WHO prerequisites for promotion of CPCFs. National governments must adopt global guidance into national regulatory frameworks and enforce national regulations before global policies can aid in improving the quality of commercial foods fed to older infants and young children.

Keyword: commercially produced complementary food, infant and young child nutrition, infant and young child feeding, Codex Alimentarius, WHO guidance

Conflict of Interest Disclosure: None

PAB(T9-48)
Early program assessment of the Haryana wheat flour fortification program, India

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Background & Objective: In 2018, a wheat flour fortification program with iron, folic acid, and vitamin B12 fortificants was established within the government-run Public Distribution System (PDS) in Ambala District, Haryana, India to address micronutrient deficiencies. PDS provides basic food and non-food commodities to the families below poverty level at subsidised prices. This study aims to assess household fortified wheat flour consumption among PDS recipients.

Methods: In 2021, we conducted a household survey and interviewed women aged 18-49 years (WRA) about consumption of wheat flour. A systematic probability sample design was used to select 358 households with WRA from a listing of all household beneficiaries enrolled in PDS who were living in the Naraingarh and Barara communities in Ambala District where the wheat flour fortification program was implemented. We assessed the percentages of households who have received and consumed fortified wheat flour from PDS, and assessed the perceived quality of fortified wheat flour compared to non-fortified wheat flour from other sources. <

Results: We were able to reach 88% of the selected households (314/358) and 291 WRA agreed to participate (response rate 93%). Almost 99% (288/291) of households were eligible to obtain fortified wheat flour through PDS and among those eligible, 285 (99%) obtained fortified wheat flour monthly. Household consumption of fortified wheat flour was 98%, and 71% consumed all the fortified wheat flour supply before consuming other non-fortified wheat flours. Among households that reported consumption of fortified wheat flour, 63% reported quality of the fortified wheat flour was similar or better than non-fortified wheat flour from other sources.

Conclusions: Receipt and consumption of fortified wheat flour among PDS beneficiaries was very high. A majority of households reported consumption of fortified wheat flour first before other non-fortified wheat flour and that the quality of fortified wheat flour was similar or better than other non-fortified wheat flour. Periodic assessment of the wheat flour

fortification program would be helpful to ensure continual high consumption of fortified wheat flour by PDS beneficiaries.

Keyword: Wheat flour fortification, Assessment, India

Conflict of Interest Disclosure: None

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PAB(T9-49)

Assessment of maternity protection policies in the Philippines and their role in creating an enabling environment for breastfeeding

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Background and Objectives

The Philippines has enacted maternity protection policies, such as the Expanded Maternity Leave Law and the Expanded Breastfeeding Promotion Act, to create a more enabling environment for breastfeeding. Our objective was to review the content and implementation of maternity protection policies in the Philippines, examine their impact on women in the workforce, and determine the role of policy interventions in improving breastfeeding practices in workplaces.

Methods

Policies, guidelines, and related documents on maternity protection were reviewed and their contents compared with international recommendations. In-depth interviews were conducted with policy makers, employers, employed pregnant women, mothers of infants, and mothers' partners. Data were analyzed with thematic analysis using NVivo software.

Results

Results indicated that the Philippines' policies on maternity protection are aligned with the majority of International Labor Organization recommendations, except for 1) coverage of maternity leave payments for all, including informal workers, and 2) allocation of public or social funds for paid maternity leave. Although policies are in place, gaps in monitoring and enforcement systems to ensure functionality and uptake of services for breastfeeding were observed. Barriers to uptake of maternity entitlements, especially in the informal sector, exist. The current policies to support breastfeeding in workplaces do not necessarily translate into improved breastfeeding practices. This is due to poor communication of entitlements, and insufficient breastfeeding support and promotion within workplaces. Due to inadequate breastfeeding assistance and advocacy, challenges to continuing breastfeeding while working can overpower mothers' decisions to breastfeed their baby. The Philippine maternity protection policies operate separately from breastfeeding promotion programs, resulting in poor recognition of how maternity entitlements are intended to enable breastfeeding.

Conclusion

Although maternity protection policies are in place, they are not yet aligned to create an enabling environment to improve and sustain recommended breastfeeding practices. Strengthening enforcement mechanisms and revisitation of entitlements in the workforce are needed. Partnerships with both government and breastfeeding advocates are needed to strengthen breastfeeding advocacy in workplaces, by facilitating the creation of technical assistance and educational materials as well as assist in crafting corporate procedures and advocacy plans. Lengthening maternity leave duration to align with the recommended six months of exclusive breastfeeding may improve breastfeeding practices.

Keyword: maternity protection, maternity entitlements, breastfeeding, Philippines

Conflict of Interest Disclosure: None

Further Collaborators: This work was supported in part by the Bill & Melinda Gates Foundation (Grant Number OPP50838) and Irish Aid. The views and opinions set out in this article represent those of the authors, and do not necessarily represent the position of the Bill & Melinda Gates Foundation or Irish Aid.

PAB(T9-50)

Trends for early initiation of exclusive breastfeeding under six months in DRC : results from the Multiple Indicator Cluster Surveys of 2001, 2010 and 2018

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Background and objectives: Breastfeeding is one of the most effective ways to ensure child health and survival. According to the WHO, increasing rates of exclusive breastfeeding can help drive progress against other global nutrition targets. This practice is one of the most powerful tools that policy-makers have at their disposal to improve the health of their people and their economies. Despite progress made generaly in the country, some regions have still now low proportion of exclusive breasfeeding. The current study provides an update in national trend in exclusive breastfeeding from 2001 to 2018, taking advantage of data from the multiple indicator

cluster surveys to see the progress toward the Global nutrition targets.

Methods: Data from three waves of the Multiple Indicator Cluster Survey for 2001, 2010 and 2018 were used to estimate crude the trends over time for two outcomes, early initiation of BF and exclusive BF. We assessed the national and provincial trends of these two indicators.

Results: The trend in breastfeeding is growing generaly, within one hour of delivery, exclusive breasfeeding and breastfeeding up to the age of 2 years. Breastfeeding is high in rural areas and is increasing, except in 2001 when the AME was higher in urban than in rural areas.

Conclusion: Our results suggest to improve breastfeeding practices in the country to achive the Global nutrition targets and especially in urban areas. Child nutrition programmes worldwide continue to require investments and commitments to improve infant feeding practices in order to have maximum impact on children's lives.

Keyword: Breasfeeding

PAB(T9-51)
Breastfeeding related services and practices among women in Madina community

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Background and objectives: The global breastfeeding scorecard data revealed that the prevalence of early breastfeeding initiation and exclusive breastfeeding were 43% and 43.5% respectively. Some breastfeeding-related services have been provided to help enhance breastfeeding practices worldwide. These have been of help but are still not effective enough to obtain optimal breastfeeding practices in Ghana. This study aimed to assess the breastfeeding-related services and practices among women in the Madina community.

Methods: The study was cross-sectional and included 150 mothers with infants aged 1-24 months attending post-natal/child welfare clinical services in two health facilities in Madina. Semi-structured questionnaires were used to assess their knowledge on breastfeeding, factors that influence breastfeeding, challenges associated with breastfeeding, and the breastfeeding services provided to them (using the ten steps to successful breastfeeding of the baby-friendly hospital initiative). Data were analyzed using SPSS version 26.0. Bivariate analysis (Fisher's exact test) was used to analyze the relationship between the breastfeeding practices of the mothers and the services provided.

Results: The percentage of respondents who had knowledge on early initiation and exclusive breastfeeding were 92.7% and 84.7% respectively. The prevalence of early breastfeeding initiation and duration of exclusive breastfeeding was 68.5 and 50.2% respectively. The average overall breastfeeding services score was 6 out of 8. The relationship between the aid to initiate on time and the actual initiation of breastfeeding among mothers was statistically significant (p-value = 0.00) There was no association between the other services such as; rooming-in (p-value = 0.29), how to maintain lactation without infant (p-value = 0.22), referral to a breastfeeding support group (p-value = 0.58) and the exclusive breastfeeding practices of the mothers.

Conclusions: There was no association between rooming-in, maintaining lactation without an infant, referral to a breastfeeding support group, and the mother's breastfeeding practices. Therefore the breastfeeding-related services and practices of the women in Madina are sub-optimal.

Keyword: Breastfeeding-related services, Baby-Friendly Hospital Initiative, Early breastfeeding initiation, Exclusive breastfeeding

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PAB(T9-52)
Consideration of adolescent nutrition in Senegalese policies: a scoping review

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Background and objectives: Adolescents have only recently been recognized as a priority nutrition target group at global level. Although some nutrition interventions are implemented, there is a lack of data on their nutritional status and diet to guide them, especially in developing countries. This work aimed to identify adolescent nutrition gaps in policies in Senegal compared to the global level.

Methods: A Literature review was carried out to collect global guidelines on adolescents from the health organization websites and PubMed. Then, the official websites of the 12 sectors involved in the multisectoral strategic plan for nutrition in Senegal were visited to collect national documents using the following keywords: policy, nutrition, adolescent, sector, letter, program, plan, and strategy. Other global and national relevant documents were also collected from main resource persons of the different sectors. Documents were identified and reviewed by using key words such as nutrition, adolescent, indicator. An Excel template was developed and used to collect data on strategic areas, nutrition interventions, gender mainstreaming, multisectoriality, nutrition indicators and to analyze its consideration according to World Health Assembly (WHA) targets.

Results: Overall, 11 global and 52 national documents were collected and reviewed. The main gaps identified in global policies were the missing of specific target and nutrition and dietary indicators for adolescents. At national level, only 16 documents mentioned directly the adolescents and 7 of its mentioned nutrition among adolescents, especially in health and education sectors. Only health sector included adolescent nutrition indicators and 3 sectors included nutrition interventions. Gender mainstreaming among adolescents were

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

poorly highlighted in documents, only in 6 documents. The difference by sex was not consider in nutrition indicators. In comparison to the global level, Senegal was aligned to supplementation intervention but not to obesity and overweight indicator. Dietary and wasting indicators were also identified as gaps at global and national level.

Conclusions: This review revealed limited information that reflected the low level of adolescent nutrition consideration in Senegalese policies. Therefore, further attention should be paid to the definition of indicators and interventions and a better consideration of gender at national level.

Keyword: Adolescent, policies, nutrition indicators, Senegal, interventions

PAB(T9-53)
Trial of simulation-based learning practice for dietetic students using online systems

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Background and objectives: Simulation-based learning practice has been widely used among health professionals. In this study, we conducted online SP (Simulated Patient) practice on dietitian students using two scenarios with interviews on nutritional needs and a dietary survey for diabetes patients, and examined the problems and effects.

Methods: Twenty-seven third-year students in a 4-year registered dietitian course were enrolled. Students were divided into groups of six or seven persons and into two teams, with one team conducting SP and the other team observing. Before the simulation activity, the facilitator provided information on the case scenario and SP practice lasted approximately 30 minutes, including the simulation activity and debriefing. After the practice, we evaluated students' perceived achievement, whether the scenarios were realistic, ease of conducting interviews with other students, equipment used and reception status through a web survey.

Results: Fifty-two percent of students answered that they had sufficiently achieved their learning goals, and the rest of the students said they had achieved some of their goals. The students who answered that they sufficiently achieved their learning goals were also highly likely to be able to “act like the scenarios were reality” and “interview with other students”, even online. Most students did not have any problems with audio or image quality, and these were not related to achievement of learning goals. Half of the students answered that face-to-face interactions are better for reading emotions from others' facial expressions.

Conclusions: SP practice can be conducted online, but there are some limitations. Therefore, it is effective for communication learning to be performed in combination with face-to-face learning.

Keyword: online systems, patient simulation, dietetics
Conflict of Interest Disclosure: None

PAB(T9-54)
The applicability of quantum computers to nutritional problem

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Background and objectives: Japan is facing a super-aging society, and increasing national medical expenses and extending healthy life expectancy due to an increase in lifestyle-related diseases are urgent issues. In addition, Society 5.0 has been proposed, and although it is in a period of major social change such as the rise of artificial intelligence, there is an urgent need to adapt it to the fields of nutrition and health science. It is enormous to realize the optimal individual medical / nutrition guidance and public health problem policy for each individual corresponding to lifestyle, biometric data, genomic information and disease risk, including automatic menu creation called kitchen informatics and recipe devising. Since it is necessary to handle various data in a complicated manner and conventional computers and statistical methods are insufficient, it is necessary to utilize next-generation computers such as quantum computers, and it is also advantageous in terms of high speed and power saving.

Methods: We tried to nutritionally optimize the simplest snacks in combination. We prepare to build a model that can be used practically with a quantum computer or that optimizes a simple combination of nutritionally appropriate food selection and menu settings on a trial basis. In the quantum computer, Quadratic Unconstrained Binary Optimization corresponding to the Ising model $H = J_{ij} S_i S_j + h_i S_i$ was calculated using Python, D-wave Leap and IBM qiskit.

Results: It is shown that the energy of snacks is expressed as a combination in the following range of vitamin and mineral condition values, such that 200 kcal or less, which is 10 to 15% of the estimated energy requirement for 6 to 7 years old, is appropriate (Lipid energy ratio 30% or less, protein 4.4 g, Ca 76.3 mg, iron 0.86 mg, Vit.B_1, B_2, C 0.1,0.12,7.4mg or more, respectively) in Japan. Foods high in calcium (milk, cheese, pudding, yogurt), foods high in vitamins (fruits, green tea, orange juice) were selected.

Conclusions: Although there are still barriers to practical application, it was suggested that quantum computers could be used for nutritionally appropriate food selection and menu settings. It seems that condition setting, numerous simulations, and development are required.

Keyword: Nutritionally appropriate, Society 5.0, Snacks, Kitchen informatics, Quantum computers

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-55)
Exploring input characteristics that influence the development and functioning of a North and 3South Higher Education Institutions (HEIs) partnership: a GROWNUT-2 case study

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Background: Partnerships between countries in the global north and south are crucial for improving global health inequities and achieving the Sustainable Developments Goals (SDGs). North-South partnerships between Higher Education Institutions (HEIs) play an important role in the sharing of skills and resources to improve global health outcomes. However, it is vital to build partnerships that are tailored to the specific needs of south partners to improve sustainability of collaborative projects.

Methods: The GROWNUT-2 partnership aims to develop a cadre of African nutrition scholars and academic leaders to address nutrition disorders and influence nutrition policy in Democratic Republic of Congo (DRC) and Tanzania. Using the Bergen Model of Collaborative Functioning (BMCF), the study formatively evaluates the GROWNUT-2 partnership functioning in developing and implementing a Nutritional Epidemiology curriculum program in (DRC) and Tanzania. The study utilises Participatory Action Research (PAR) methods embedded in qualitative research approach. The study will be conducted in three phases over the three year study period. In this paper we report findings from phase one of the study, where in-depth interviews (IDIs) were conducted with principal investigators, finance administrators, supporting staff, and stakeholders in each site to explore their initial perceptions of the partnership functioning and challenges experienced.

Findings: The participants understood the mission to be building research capacity in DRC and Tanzania through the development of a master's and PhD program based on the nutrition priorities in DRC and Tanzania. Building strong relationships, communication, sharing of resources/expertise, and having a common vision about the project were mentioned by the participants to be important factors in building a successful partnership and achieving the partnership goals. However, finances and financial administration were reported to be a challenge in the functioning of the partnership. The North partner oversees funding allocation to ensure this is aligned to the requirements of the funder, and this creates a hierarchy in decision making between partners.

Conclusion: Phase one of study indicates that the partners are committed to building a successful and sustainable partnership through the input factors mentioned by partners

Keyword: Partnerships, Nutrition, North, South, Research

Conflict of Interest Disclosure: None

Further Collaborators: GROWNUT-2 project partners

PAB(T9-56)
Development of the advanced education and networking offer *Diätetikforum Fulda* in participation with the target group dietitians

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Background and objectives: An involvement in networks can offer an added value for dietitians. The *Diätetikforum Fulda (DF)* is a regional network for advanced education and professional exchange initiated by the transfer project MoDiVe of the Hochschule Fulda – University of Applied Sciences for education and implementation of process guided work. Participation is a central quality criterion which should enable an active integration of the target group and a sustainable constitution beyond the termination of the MoDiVe-project. The research question was: How can the DF be sustainably implemented in participation with the target group dietitians of the region East Hesse – Germany?

Methods: A structured literature research was conducted and an evaluation concept developed. Eight guided interviews with participants of the DF were analysed using the *Qualitative Content Analysis by Mayring*. The achievement of goals so far by the DF was checked with the results of the evaluation. Recommendations for a participative further development of the DF were derived.

Results: The DF is currently the only offer of this type in East Hesse – Germany. Main motives and incentives for attendance are establishing contacts, exchanging experiences and knowledge about process guided work, receiving continuing education credit points and the regional anchoring. The events, especially the topics and the participative mode of operation get largely positive feedback from the interviewees. An exchange of experiences in the events is quite possible but limited to them. In the DF a potential is seen to increase the regional visibility of the occupational field. The majority of the interviewees express willingness to participate actively in the format which can support a sustainable establishment. All interviewees wish for continuity of the DF.

Conclusions: The differentiated evaluation shows that the DF has already achieved positive results. The current concept of the format has proven itself. The following recommendations are made for a participatory further development of the DF: Expand networking and exchange of experiences of regional dietitians, 1158rganize and carry out feedback loops, secure the results of discussion and use them for further strategies, continue regular evaluations, plan consolidation and create sustainable structures, become more visible through public relation activities.

Keyword: dietitians, advanced education, networking, professional exchange, participation

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-58)
Survey on the Use of Health Supplement in Malaysia

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Background and objectives: Demand for health foods expected to increase as the aging society in the World. However, it is considered that the demand and distribution of health foods differ depending on the social background, such as ethnicity and religion, and lifestyle of each country. In this study, a survey was conducted in Malaysia, a multi-ethnic and multi-religious country, to clarify the relationship between the use of health foods (Health Supplement in Malaysia:HS) and ethnicity/religion. <

Methods: In July 2018, online survey was conducted for Malaysian (Rakuten Co,,Ltd, Japan). The subjects were 300 people aged 20 to 70 (150 men and 150 women). The contents of the survey consisted of attributes (ethnicity, religion, occupation, residence type and etc.), HS (image, health claim, approval agency, Halal labeling, use or non-use, purpose of intake, type, frequency and etc.), and lifestyle habits (dietary intake, exercise, sleep and etc.). All data was analyzed using IBM SPSS, Ver.27.0.

Results: There was a significant relation between ethnicity and religion, with Malays being Muslims, Chinese being Buddhists, and Indians being Hindus. There were no characteristic differences in HS usage among lifestyle, ethnicity and religion. However, Halal logo in HS had been checked by many Malays and Muslims. Approximately 60% of all subjects were currently using HS and 36% had previously. The main purpose of HS was health promotion. The HS mainly used was vitamins and minerals, but the traditional Malaysian health foods was also used. Dispensing pharmacies were the most popular purchase method. About 75% knew the legal definition of HS (Ministry of Health, Malaysia). The most required level of HS claims was 'health promotion'. The national/governmental bodies were considered suitable as HS certification bodies.

Conclusions: There was no significant difference between Malaysian ethnic groups (Malays, Chinese, Indians) and HS use and lifestyle habits. It was revealed that Malays and Muslims believe that HS should have a Halal logo and that they confirm this at the time of purchase.

Keyword: Health Supplement, Malaysia, Halal logo

PAB(T9-59)
Comparison of the policies on dietary supplements among the USA, China, and South Korea

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Background and objectives: As interest in and demand for dietary supplements have increased worldwide, many countries are developing policies to regulate them. This study aimed to compare the policies on dietary supplements in the USA, China, and South Korea.

Methods: The data was collected from the websites of government agencies in each country. We compared the terms, definitions, and policies of dietary supplements and the institutions establishing and implementing policies on dietary supplements among these three countries.

Results: The terminology for dietary supplements varies slightly among the three countries: 'dietary supplement' in the USA, 'health food' in China, and 'health functional food' in South Korea. Nevertheless, they are all defined as foods that are beneficial to health. In the USA and South Korea, it is the food and drug government agencies that administrate policies on dietary supplements, while the State Administration for Market Regulation assumes this role in China. There is no approval for pre-marketing dietary supplements in the USA, hence the word "dietary supplement" is usually displayed on the products. In contrast, China and South Korea allow the "health food" or "health functional food" mark to be attached on the products only if they are approved by government agencies. Because the USA has no singular official standards regarding ingredient management, a set procedure is required only when a new dietary ingredient (NDI) is used for a dietary supplement. 87 types of ingredients are subject to the Chinese registration system for dietary supplements. Korean functional raw materials are managed separately from publicly announced raw materials (96 types) and individually recognized raw materials (33 types). China indicates the suitable group in addition to the basic product information on the label, while the other two nations indicate the allergy ingredients. These three countries all implement laws and regulations such as ingredients, labeling, good manufacturing practice (GMP), and guides for dietary supplements in common.

Conclusions: Despite the above differences in the policies on dietary supplements, the USA, China, and South Korea all actively implement them. Considering such national differences may be helpful in benchmarking for future promotion in the field for dietary supplement policies.

Keyword: Dietary supplements, Functional food, Policy, Regulation, South Korea

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-60)
Body composition measurement and risk factors for Non-Communicable Diseases (NCDs) among migrant workers in Chiangmai, Northern Thailand

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Introduction: Quite a few migrant workers from Myanmar reside and work in Northern Thailand, especially Chiang Mai. A cross-sectional face-to-face interview survey was conducted to measure their body composition and study potential risk factors for Non-Communicable Diseases (NCDs).

Methods: With written informed consent, we recruited study participants in December 2017. Based on WPRO WHO guidelines, Body Mass Index (BMI) was categorized into three groups: normal, overweight, and obese. Central obesity was determined by using WHO cutoff points for sex specific waist and hip ratio. Using a questionnaire, trained interviewers who were able to speak the languages of study participants (Thai, Myanmar, and Shan languages) collected information regarding risk factors.

Results: The mean age of the respondents (n=414) was 29.5+-9.0. 231(55.8%) were male and 183 (44.2%) were female. The average length of years of stay in Thailand was 6.36 +-5.70. Based on BMI, 16.4% were overweight and 4.3% were obese. 25.8% were found with central obesity. Four (1.0%) reported that they were diabetic, while 18 (4.3%) never got tested. Regarding the health risk behaviors, 75.8% had no habit of regular exercise, 26.3% were currently smokers. 40.8% drink alcohol, and 68% did not have enough sleeping hours. 310 (74.9%) reported 7 days (everyday) to the question asking how many days in the last week they ate vegetable.

Discussion: As high prevalence of hypertension (27.8%) was observed from the same study group (reported elsewhere), our body composition measurement showed that over 20% of the study participants were overweight/obese. Body composition measurement is important to detect hypertension and other NCDs. Overweight and obesity levels in Thailand have been steadily increasing over the years. Thailand came second after Malaysia in the ranking of obesity in the ASEAN region. Appropriate intime health/nutrition education intervention is necessary to control the rise of NCDs among migrating valuable populations in the region.

Keyword: Body Mass Index(BMI), Non-Communicable Diseases (NCDs), Myanmar migrant workers

PAB(T9-61)
Analysis of non-communicable diseases policies, and implementation in Nigeria

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Background: Despite efforts by the Nigerian government to develop and adopt policies to reduce the burden of non-communicable diseases (NCD) and their mortality. 29% of all death in 2019 was attributed to NCD and this has consistently increased over the years in Nigeria.

Objective: This paper appraises government efforts in formulating, implementing policies and programs that will reduce the burden of non-communicable diseases in Nigeria.

Methods: A descriptive desk review design to analyze national and state policies on non-communicable diseases prevention and management. Policy search was done using scoping review of electronic search of Google and online databases (Google Scholar, Science Direct, and PubMed) to identify articles and policy documents with no date restrictions. Public documents, reports, or articles relevant to policy formulation and implementation were identified. Appropriate findings from all the articles were reviewed systematically.

Results: Our findings revealed that the Nigerian government and relevant stakeholders have adopted credible national policies and plans of action to curb NCD risk factors. Although, there is no decentralization for states' policy implementation. Bans on the promotion of tobacco use, increased excised tax on alcohol, sugar tax, food label regulation, breast milk substitutes marketing restrictions are implemented. However, these policies have not been fully implemented within the country; there has been a paucity of awareness to sensitize people to adopt a healthy diet and lifestyle, guidelines for prevention and management of NCD are not implemented. Nigeria is not on track for achieving NCD targets and indicators for UN Sustainable Development Goals to reduce one-third premature NCD deaths by 2030.

Conclusion: The use of sustainable policy implementation strategies may likely contribute to a reduction of the burden of non-communicable diseases. We recommend strict compliance monitoring and accountability for ongoing programs in Nigeria. Simultaneously, routine screening for NCD risk factors to identify people at high risk for early management to curb NCD premature deaths

Keyword: Non-communicable Diseases, Policies, Implementation strategies, Nigeria

Conflict of Interest Disclosure: None

Further Collaborators: None

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-62)

Non-communicable diseases in Morocco: results from World Health Organization STEPS survey

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Background and objectives: Noncommunicable diseases (NCDs) are the leading cause of death across the world. In 2016, they were the cause of 40 million deaths. In this blackboard, we find the deaths from cardiovascular diseases (CVD), with a share of 50% in the total deaths (WHO, 2019). The prevalence of this type of pathology is explained by sedentary lifestyles and the main risk factors, such as hypertension, diabetes and obesity. The aim of this survey is to determine the prevalence of common risk factors for NCDs in adults. **Methods**: We used the STEPwise approach of the World Health Organization (WHO) through a questionnaire, physical and biochemical measurements. The survey pooled data from 5,429 people. **Results**: overall, the incidence of overweight and obesity was higher in women (34.4% and 29%) than in men (31.6% and 11%) respectively, more pronounced in urban areas (34.7 % and 22.8%) than in rural areas (29.8% and 14.9%). For high blood pressure, the values were almost identical between women (29.8%) and men (28.7%) whether in rural (29.9%) or urban (29%). For diabetes, there was a prevalence of 12.6% for women, 8.6% for men and a higher incidence in urban areas (12.1% against 8% in rural areas). **Conclusion**: This survey will update data on NCDs risk factors in Morocco, given that the most recent values are 17 years old. Thus, we will be able to update, adapt and improve the various strategies put in place by the WHO and the Ministry of Health.

Keyword: Non-Communicable diseases, Cardiovascular diseases , risk factor, lifestyle, STEPS Survey

PAB(T9-63)

Peri-conceptional diet and the risk of gestational diabetes mellitus in South Indian women – findings from the BAngalore Nutrition Gestational diabetes LiFEstyle Study (BANGLES)

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Background and objectives: Gestational diabetes mellitus (GDM) affects 20% of Indian pregnancies[1]. Diet may be important to prevent GDM[2], but data from India is sparse. BANGLES investigated the associations between women's 'peri-conceptional diet' and GDM risk. **Methods**: BANGLES was a prospective observational study (n=785), in which women of various socioeconomic-status were recruited at 5-16 weeks' gestation. Peri-conceptional diet was recalled at recruitment, using a validated 224-item Food Frequency Questionnaire, that was reduced to 21 food-groups for the food-group-GDM analysis, and 68 food-groups for the principal component analysis (PCA) for a diet pattern-GDM analysis. Diet-GDM associations were examined using multivariate logistic regression, adjusting for '*a priori*' confounders determined from the literature. GDM was assessed by a 75-gram Oral Glucose Tolerance Test at 24-28 weeks' gestation, applying WHO 2013 criteria. **Results**: Women who consumed: whole-grain cereals (aOR: 0.58, p=0.03), moderate egg (>1-3 times per week) compared to < 1/ week (aOR: 0.54, p=0.01) and a higher weekly intake of pulses and legumes (aOR: 0.81, p=0.03), nuts and seeds (aOR: 0.77, p=0.01) and fried and fast food (aOR: 0.72, p=0.002) had a lower GDM risk. None of these associations were significant (p< 0.05) after correction for multiple-testing. Using PCA we identified 3 diet patterns: a) High-diversity, urban (HDU) characterised by diverse, home-cooked and processed foods was associated with older, affluent-educated-urban women; b) Rice-fried snacks-chicken-sweets (RFCS), characterised by low diet-diversity, was associated with younger, less-educated, and lower income-rural-joint families; c) Healthy, traditional vegetarian (HTV), characterised by home-cooked-vegetarian and non-processed foods was associated with less-educated and affluent-rural-joint families. The HDU pattern was associated with a lower GDM risk (aOR: 0.80, 95% CI: 0.64, 0.99, p=0.04). BMI possibly mediated diet-GDM associations. **Conclusions**: The same food-groups that were associated with a lower GDM risk were components of the HDU pattern. The findings suggest that one 'healthy' diet pattern may not be relevant to India[3]. They support global recommendations to encourage women to attain a healthy pre-pregnancy BMI [4] and increase diet-diversity [5] & [6] to prevent GDM. Findings support evidence for national policies to increase the affordability of wholegrains, fruits and vegetables to achieve diet-diversity[5].

Keyword: peri-conceptional diet, food-groups, diet patterns, India, gestational diabetes

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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Conflict of Interest Disclosure: None

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PAB(T9-64)

Home blood pressure monitoring and its associated factors among hypertensive patients in 3 counties of Guizhou Province

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Background and objectives: The study determined the status and factors associated with hypertensive patients' use of home blood-pressure monitoring (HBPM) in primary care in Guizhou Province China.

Methods: Randomized crosssectional questionnaire survey of hypertensive patients managed in Renhuai City, Yuping County and Fenggang County of Guizhou Province. The study was conducted 2230 hypertensive patients.

Results: The proportion of HBPM was 32.8%. The results of logistic regression analysis showed that hypertensive patients with following characteristics were more likely to have HBPM behaviors: Living in a city or town (OR=1.747, 95% CI: 1.326-2.302), Han ethnicity (1.709, 1.345-2.172), family history of hypertension (1.461, 1.193-1.790), junior high school education or above (1.361, 1.048-1.766), central obesity (1.320, 1.046-1.666), married (1.277, 1.011-1.613).

Conclusions: Family history, Han nationality, urban residents, central obesity, married and higher educational level are related to the use of HBPM.

Keyword: Hypertension, Home blood pressure monitoring, Influencing factors, Basic public health

PAB(T9-65)

Comparative laboratory validation of blood sampling methods and analytical devices in the measurement of hemoglobin in population surveys

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Background and objectives: Using different hemoglobin [Hb] assessment methodologies in population-based surveys has resulted in differences in anemia prevalence estimates and led to uncertainty among policymakers on best practices for reducing anemia. The aim of this laboratory-based multi-site comparative cohort study is to identify the most appropriate procedures and methods for Hb assessment in population surveys. The mode of blood collection (venous versus capillary, and the latter pooled or a drop) and other factors can influence the accuracy and precision of Hb measurements.

Methods: This study is being conducted in Cambodia, Ethiopia, Guatemala, Lebanon, Nigeria, and Tanzania. Each study site will include up to four cohorts of apparently healthy participants (women 15–49 years of age and children 12–59 months of age). Each cohort will be recruited to resolve one aspect related to Hb concentration measurement using venous and capillary blood samples via three different HemoCue® device models (201+, 301, 801) and a certified autoanalyzer. One cohort will provide a single venous and a pooled capillary blood sample to compare the accuracy of venous Hb measurements between autoanalyzer and HemoCue models, and between venous and pooled samples on all devices. Other cohorts will provide a single venous and a single-drop capillary blood sample to compare results of venous Hb measurements between an autoanalyzer and one of the three HemoCue models and also between venous and single-drop samples for the three devices. We will evaluate each device in a separate cohort to decrease participant burden by conducting only one fingerprick per participant.

Results: Data collection in all six study sites will be completed by June 2022. For the pooled sample and for each site, we will estimate concordance and correlation coefficients by comparing HemoCue Hb concentrations from different types of blood samples to a venous blood sample from the same individual measured via autoanalyzer. Agreement and bias among the methods will also be evaluated. Across study sites, we will compare results from similar cohorts to assess inter-site variability.

Conclusions: Results will provide insight into the reliability of different blood samples and analytical devices for Hb determination in population surveys.

Keyword: hemoglobin, autoanalyzer, Hemocue, venous, capillary

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

Conflict of Interest Disclosure: None
Further Collaborators: N/A

PAB(T9-66)
Understanding the association between low-dense nutrition food and mental disorders: a systematic review

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Background and objective: With the rising global prevalence of mental disorder, the urgency to seek its further risk factors become more apparent. This research reviews existing articles to identify evidence of the association between mental disorders with low-dense nutrition food intake.

Methods: A systematic search was conducted on four online databases including JSTOR, Cambridge Core, Scopus, and ProQuest. 484 articles from the initial search were further reviewed referring to the inclusion and exclusion criteria until 10 eligible final articles obtained. The final articles consist of selected study design of cohort, case control, or intervention studies. There were variations in age group settings and the operational definition of low-dense nutrition food in the final articles which are going to be discussed further.

Results: Literatures analysed showed different correlation between the two variables. 8 studies showed positive correlation between low-dense nutrition food intake and the risk of mental disorders (depression, anxiety, and ADHD). In contrast, the other 2 studies showed insignificant correlation between intake of low dense nutrition food and the onset of mental health disorder, specifically to sugar sweetened beverages consumption.

Conclusions: This systematic review shows that there is a strong relationship between low-dense nutrition food intake and the risk of mental disorders. The understanding arises on the basis that this review only include research with study design that can indicates causal effect relation between its variables. Further research upon similar topics with an abundant resource of database is encouraged to be conducted in order to gain deeper and broader comprehension.

Keyword: low-dense nutrition food, mental disorder, anxiety, depression

PAB(T9-67)
Analysis of an effective combination of multisectoral interventions for stunted children

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Background and objectives: Without especially addressing the first 1,000 days, healthy development and growth of children, and sustainable economic activity are not possible. While both nutrition-specific and nutrition-sensitive interventions are needed to eliminate maternal and child undernutrition, there is insufficient evidence on how to combine them effectively. This study aims to examine which combination of multisectoral interventions effectively reduces stunted children under 23 months of age.

Methods: Individual data from 17 African and 7 Asian countries in the Demographic and Health Surveys (DHS) program were pooled in a cross-sectional dataset. A regression analysis was then conducted where the prevalence of stunting of children under 23 months of age is the objective variable, and the indicators of interventions in health (e.g., ANC attendance), food (e.g., Minimum Acceptable Diet), and WASH (e.g., access to improved water) sectors are explanatory variables. R version 3.6.2 was used for the analysis. ~

Results: Of the total sample of 56,406 children under 23 months of age, only 2% received services from all the three sectors of health, food, and WASH, indicating that few children benefit from multisectoral interventions. Results of the cross-sectional analysis show that the interventions of food only, WASH only, and combination of the interventions of these sectors are not significant for the reduction of stunting. However, when the intervention of one of these sectors is combined with that of health, the reduction is significant. Furthermore, the absolute value of the coefficient increased as the number of intervention sectors increased. This trend was the same for the African and Asian countries, and all countries.

Conclusions: The results suggest that multisectoral interventions to reduce stunting are more effective as the number of sectors increases, and that a combination with health sectors is effective.

Keyword: multisectoral intervention, stunting reduction, nutrition-specific interventions, nutrition-sensitive interventions

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-68)
Current status of HACCP-based food hygiene control implementation in Viet Nam hospital kitchens

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Background and objectives: Hospital meal should promote nutrition care management and quality of life among inpatients. Although the HACCP-based food hygiene control in hospital is necessary to ensure safe food service, it has been unclear whether Vietnamese hospital kitchens properly apply that. This study aimed to describe the current status of HACCP-based food hygiene control in Vietnamese hospital kitchens, and to identify major food processing hazards to prevent foodborne diseases caused by patient meals.

Methods: A self-administered survey was conducted across 17 hospitals of grade II and above in major cities, Ha Noi, Ho Chi Minh and Quang Ninh province in Viet Nam, via the Internet. The questionnaire comprised three main sections; 1) Attributes of the facility (20 items), 2) Compliance status of food hygiene control (70 items), 3) Attribute of respondents (3 items). Responses are scored on a Likert scale ranging from none (0) to excellent (3). The Chi-squared test, Spearman's correlation analysis, analysis of variance, and the Kruskal–Wallis test was used to compare characteristics.

Results: The present analysis included 14 hospitals and showed that some questions relating to temperature, hand washing, hand sanitizing, and cutting boards, the average scores were lower than “Acceptable” (i.e. < 2 points). The majority of low-score questions on food hygiene control were related to microbiological hazards. The total number of kitchen staff was positively correlated with the questions about pollutants in the kitchen, patient meal time, and cooked food temperature. A positive correlation was found between the patient meal service time and the question about the cooking process. There was no statistically significant correlation between the number of dietitians and the food hygiene control questions.

Conclusions: The present findings implied that the current status of HACCP-based food hygiene control in some Vietnamese hospital kitchens is partially inappropriate. The nutrition department should pay more attention to critical control points, such as cooking time and temperature. Human resources may play important roles in kitchen hygiene.

Keyword: HACCP, food hygiene control, Vietnamese hospital kitchen

PAB(T9-69)
UK Dietitians' understanding of the nutrition and health properties of mycoprotein: findings from a survey.

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Background and objectives: Mycoprotein is a protein derived from the fermentation of filamentous fungi, e.g. Fusarium venenatum. Foods derived from mycoprotein have been available to consumers since the 1980s (e.g. Quorn, 1985). Mycoprotein is well-documented as being a source of protein, fibre and micronutrients, and of having a low environmental impact. Human research has demonstrated that mycoprotein can support skeletal muscle protein anabolism in both young and older adults. Additionally, mycoprotein consumption has been shown to lower total and LDL cholesterol concentrations and improve acute postprandial glycemic control in humans.

Methods: To assess dietitians understanding of both the nutritional and health properties of mycoprotein consumption, all dietitians who are members of the British Dietetic Association (BDA) were invited to participate in an online survey (Google Forms, Menlo Park, California) via e-mail between 25th November and 18th December 2021. The survey assessed understanding of mycoprotein as part of a larger multiple-choice survey, which aimed to identify views on various public health issues. In total, four questions specifically focused on this mycoprotein benefits.

Results: A total of 188 responses were received. Respondents worked in a wide variety of specialties including 23.9% (n=45) in weight management, 18.6% (n=35) in parenteral nutrition and 16.5% (n=35) in diabetes. A total of 96.3% (n=181) of dietitians had heard of mycoprotein and 60.1% (n=113) were able to correctly identify mycoprotein as a source of protein; 69.7% (n=131) identified fibre and 81.4% (n=153) identified that mycoprotein is low in saturated fat. 54.8% (n=103) also correctly identified mycoprotein as a source of some micronutrients. When asked about clinical benefits, 43.6% (n=82) were aware of cholesterol-lowering effects; 26.6% (n=50) were familiar with the satiety effect following ingestion, and the effects on glycaemia, while 16.5% (n=31) equally were aware of protein anabolism effects, and gut health benefits.

Conclusions: We have identified knowledge gaps and misunderstandings of the nutrition and health properties of mycoprotein amongst UK dietitians. This demonstrates that there is a need to educate UK healthcare professionals about the benefits of mycoprotein in healthy, sustainable diets. These findings are likely to hold true in additional countries where mycoprotein is available.

Keyword: Fungi, Mycoprotein, Dietitian, Fungal protein, Sustainability

Conflict of Interest Disclosure: Holly Roper, Hannah Theobald and Tess Kelly are employed by Marlow Foods and provided input into the study design and interpretation of the findings.

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

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PAB(T9-70)
Survey of local residents' attitudes toward accepting Muslims in evacuation centers during disasters

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Background and objectives: In recent years, the number of Muslims has been increasing worldwide. In Japan, Muslims constitute a minority. On the other hand, the number of Muslim tourists visiting Japan is increasing. Muslims live according to Islamic precepts that prohibit the eating of pork (including its derivatives) and the drinking of alcohol. In the event of a disaster, Muslims may also take shelter in evacuation centers and may live in shelters with local residents. Therefore, this study investigated residents' attitudes toward accepting Muslim travelers at evacuation centers.

Methods: A total of 914 non-Muslim Japanese individuals (451 males and 463 females) were surveyed online. The average age of those surveyed was 44.9 years old. The study questionnaire asked respondents what they thought about accepting Muslim travelers at evacuation centers in the event of a disaster. The study was conducted after receiving research ethics approval.

Results: Regarding the acceptance of Muslims in evacuation centers during disasters, 64.9% of those surveyed answered that they “do not particularly care” or “do not mind if there is a system in place to accept them.” On the other hand, 23.1% indicated that while they would be willing to accept them, they were concerned about possible problems. Meanwhile, 11.6% did not want to accept them. Additionally, when asked if Halal food could be served in shelters on par with special meals for people with allergies or illnesses, 30.7% answered “unacceptable” or “not very acceptable.” Meanwhile, 68.9% responded that they “accept it because of religious reasons” or “do not have any particular concern.”

Conclusions: Most participants had a positive view of accepting Muslim travelers in shelters. However, participants raised some concerns about possible troubles and some negative views, suggesting that consideration for both residents and Muslims is necessary when accepting Muslim travelers in shelters.

Keyword: Muslim, Halal food, Disaster

PAB(T9-71)
In-Field Survey of Energy Expenditure during Disaster Activity Emergency Fire-Fighter Support Team Training Utilizing a Tri-axial Accelerometer and Wearable Heart Rate Monitor

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Background: An accurate estimation of energy expenditure is crucial for planning disaster relief and rescue operation as an expedition team, because they need to prepare and transport their own food supplies in advance. However, the energy expenditure of such operation remains unclear.

Objectives: Large-scale disaster response activities were sampled using tri-axis accelerometers and wearable heart rate monitors for activity training that is closer to actual activities in order to examine how much energy expenditure is there for emergency fire support personnel involved in disaster response activities clarifying the amount of energy expenditure for each of the activities.

Methods: We targeted 30 members who participated in the emergency firefighting support team Kanto Block joint training, which is one of the activity trainings that are considered to be the closest to the actual disaster response activities. Energy expenditure for each activity was examined by combining the accelerometer (AC) method and the heart rate monitor (HR) method, attained every hour. Since the survey subjects are expected to wear numerous equipment's and bend down to enter narrow spaces, they used wearable devices that are less invasive and easily portable.

Results: Energy expenditure was measured from 28 firefighters excluding two defective equipment's. The total energy expenditure (TEE) was determined to be about 4840 kcal. In addition, energy expenditure per hour (excluding resting energy expenditure: REE) (per average body weight of participants) was calculated for 10 types of large-scale disaster response activities. The energy expenditure of rescue from a narrow space was about 240 kcal, rescue from the traffic was about 260 kcal, transport of the victim was about 260 kcal, rescue search was about 270 kcal, fire-fighting was about 280 kcal, gas leak accident was about 320 kcal, rescue from sediment was about 340 kcal, rescue from tunnel accident was about 340 kcal, and rescue from high-rise buildings was about 410 kcal.

Keyword: Fire-Fighter, Energy Expenditure, Tri-axial Accelerometer, Wearable Heart Rate Monitor

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-72)

Comparison of Nutrient Analysis Values in Dishes Prepared by Cook-Serve and Cook-Chill Systems -For fish meuniere, pumpkin with mayonnaise, and sauteed beef-

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Background and objectives: This study was conducted at elderly care facilities that have a central kitchen and supply meals to Facility A and Facility B. Facility A is situated next to the central kitchen and meals are cooked and served on the same day using the cook-serve system, while Facility B uses the cook-chill system in which food delivered from the central kitchen is served after 4-5 days of cooking. As the cook-chill system includes a chilling process after cooking and reheating, the nutritional value of the food may be different compared to the cook-serve system. The purpose of this study was to compare the nutrient analysis values of dishes served at elderly care facilities using the cook-serve system and the cook-chill system, and to examine the degree to which the nutrient components of dishes prepared using the cook-chill system are retained compared to the cook-serve system.

Methods: The eligible dishes were "fish meuniere" (one main ingredient that required reheating), "pumpkin with mayonnaise" (one main ingredient that did not require reheating), and "sauteed beef" (meat and vegetables as main ingredients that required reheating), all of which were served at elderly care facilities. The nutritional analysis of the food was carried out by Japan Food Research Laboratories. The t-test was used to compare the nutrient analysis values of the two groups.

Results: Under the conditions of this study, there were no significant differences between the nutrient analysis values of fish meuniere and pumpkin with mayonnaise prepared using the cook-serve and cook-chill systems. It was considered that the same nutrients were retained in the cook-chill system. In contrast, for sauteed beef, the nutrient analysis values of water-soluble vitamins (vitamins B_1 and C) in the Cook-chill system were about 70%, and those of iron, β-carotene, and vitamin B_2 in the Cook-serve system were about 80-90%.

Conclusions: When operating with cook-chill, it is necessary to consider the cooking method and the degree of loss due to reheating.

Keyword: nutrient analysis value, cook-chill system, cook-serve system

PAB(T9-73)

Influence of the name of the green tea production area as auditory information on taste perception

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Background and objectives: It has been reported that the taste of food perceived by humans varies depending on whether or not a brand logo is present. As a result, the purpose of this study was to examine whether taste perception varies depending on the presence or absence of a brand in the auditory approach, one of the five human senses.

Methods: The subjects were 39 healthy females who were approached and consented to participate in a "Preference survey of green tea under development by a company and green tea produced in Shizuoka Prefecture." Shizuoka Prefecture is well-known in Japan for its green tea, which is widely regarded as delicious. The subjects were not informed of the study's purpose. For a total of four trials, two types of green tea, one under development and one from Shizuoka Prefecture, were presented under visual and auditory conditions. The beverage used in all four trials was 15 ml of commercial green tea from Shizuoka Prefecture. Sweetness, strength, and deliciousness were evaluated using the 100 mm Visual Analog Scale. R ver. 4.0.2.Software was used, and repeated analysis of variance was conducted.

Results: In terms of taste, green tea under development in the auditory condition was 65.21 ± 18.22 (mean ± SD) and Shizuoka green tea in the auditory condition was 69.26 ± 16.87. No significant differences were observed between these two conditions. However, there was a significant difference in the visual condition between green tea under development and Shizuoka green tea ($p < 0.05$), indicating that the same beverage tasted better when presented as Shizuoka green tea rather than green tea under development only in the visual condition.

Conclusions: This study suggests that visual information has a higher perception ratio by the five senses than auditory information. Since it is easier to make an impression with visual information, the green tea appears to be delicious. Thus, it is necessary to examine which regions are generally associated with the image of tasty green tea in the questionnaire since these regions vary depending on the food consciousness of each individual.

Keyword: Auditory Information, Taste, Green Tea, Brand, Visual Analog Scale

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-74)
Implementation of the use of iodized salt in processed foods in the Philippines: where are we now?

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Background and objectives: In the Philippines, food manufacturers are required by law to use iodized salt unless this results in adverse organoleptic effects on the product. Processed foods reportedly make up a fifth of total household food consumption. Based on estimated intake, foods such as bread, instant noodles, soy sauce, and canned sardines, could contribute 8-10% of the adult Recommended Nutrient Intake for iodine if produced using iodized salt. Understanding the contribution of processed foods to population iodine intake will help guide related iodized salt policies. We aimed to review the status and identify gaps in implementation and monitoring of the use of iodized salt in processed foods.

Methods: Desk review of documents related to the Philippines' salt iodization program and interviews regarding experiences and recommendations of stakeholders from government agencies, development partners, salt and food industries were conducted. All interview proceedings were processed using NVivo software.

Results: The Philippines has a policy requiring domestic food manufacturers to use iodized salt in packaged processed food products and declare it on the ingredients list, however, it does not specify the inclusion of imported processed foods. Unregistered domestic food manufacturers remain unregulated and unmonitored, while data on compliance of registered food manufacturers are not available. Monitoring the use of iodized salt among food manufacturers is not regularly conducted therefore compliance is dependent on internal quality control (QC).

Conclusion: Policies on the use and regulation of iodized salt in processed food products by domestic manufacturers, whether registered or not, should be revisited and strengthened. At minimum, there should be a system for reporting internal QC outcomes. Inclusion of imported packaged food products in the policy should be explored.

Keyword: Iodized salt, processed foods, quality control, imported food, policy

PAB(T9-75)
Development of “Mitate meat “ ,a product that utilizes local soybeans, and development for regional revitalization

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Background and objectives: the global movement of meatless, the use of soybean products is required. I had conducted the eating frequency investigation of the soybean product for the general consumer, and the consciousness investigation for the substitute meat. I had also run a vegan restaurant. I cooperated with the regional revitalization volunteer in the Akitakata City in Hiroshima Prefecture, and advanced this research. Using soybeans, a food resource of Akitakata City, the goal was to engage in regional revitalization activities aimed at the sixth industry.

Methods: The first meeting was held in October 2021 to confirm the purpose and product delivery method. And in December 2021, a draft recipe was prepared. In January 2022, we held our first tasting party to examine the recipes. The second tasting party was held in February 2022, and we exchanged opinions with the workshop. From March to April, we will further brush up on the recipes and shoot promotional photos and promotional videos.

Results: Based on the survey results on soybean products, we added the viewpoint that it is a product that does't contain additives as much as possible, and that it lasts for a long time. Koya-tofu and boiled soybeans last a long time, but they take time and effort to cook. Therefore, in order to realize convenience and deliciousness, this product "Mitate meat" was decided to be sold as frozen food, and rather than positioning it as an alternative meat, it was a product strategy that could be selected as a new soybean product. In addition, we selected the Human Worker's Work Center, a welfare facility for persons with disabilities in Akitakata City, as a factory to be commissioned.

Conclusions: Although it is an alternative meat market that is expanding, it is necessary to lead to food safety and regional contribution. I think that this research helps to solve the negative part for the alternative meat. As one of the SDGs initiatives, we would like to make research to promote local production and sixth industrialization. In the future, a pop-up store will be launched.

Keyword: soybean, plant-based meat, vegan, sixth industry

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-76)
Research on water hardness in soft water areas suitable for Japanese food

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Background and objectives: Japanese food has been cultivated in Japan, where a lot of soft water is available. It is known that soft water is suitable for cooking Japanese food, but what level of softness is suitable has not been studied. Therefore, we conducted research to clarify the hardness of water in the soft water area, which is optimal for Japanese food.

Methods: Calcium sulfate and magnesium sulfate, food additives, were dissolved in RO water having a hardness of 0 mg / L to prepare water having a hardness of 0, 30, 60 and 120 mg / L. The ratio of calcium to magnesium was set to 2: 1 according to the recommended amount of Japanese dietary intake standards. Using these water, cooked rice, kelp soup stock, dried bonito stock, and simmered dishes were cooked. Then, the hardness of water suitable for Japanese food was examined by measuring the taste component, texture, and sensory evaluation.

Results: Rice cooked in water with a hardness of 60 and 120 mg / L had higher amount of reducing sugar. Rice cooked in water with a hardness of 30, 60 mg / L had higher amount of amino acids. The result of the sensory evaluation was that rice cooked in water with a hardness of 60 mg / L was more preferred. More amino acids and sugars were found in the kelp and dried bonito broth extracted with water with a hardness of 0 and 30 mg / L. Since the simmered food contains minerals included in the food itself and seasonings, the difference in water hardness in the soft water area did not significantly affect the taste of the simmered food.

Conclusions: From the above, it was concluded that the hardness of water suitable for delicious Japanese cooked rice and Japanese-style soup stock is 30 to 60 mg / L.

Keyword: Japanese Food, Water Hardness, Cooked Rice, Japanese-Style Soup Stock, Simmered Food

PAB(T9-77)
Changes in the gaze movements and the sense of taste due to the different food form

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Background and objectives: As a nutritional therapy for deterioration of mastication and swallowing function, the dietary form may be changed from a normal diet to a swallowing-adjusted diet / swallowing training food such as a chopped diet or a paste diet. However, swallowing food has a large visual gap from normal food, and it leads to a decrease in appetite because of lowering it's image and taste of the food, which is one of the factors for the decrease in the amount of food consumed. In this study, we investigated the relationship between gaze movements and feeling when different dietary forms of meals were provided. Methods: Twenty healthy female university students were used as subjects. Dishes with different food forms (nomal and paste) were provided side by side on the desk to the subjects wearing the eye movement detector, and the gazing point and the line-of-sight residence time were measured within a certain period of time. We used two types of dishes, "grilled salmon with salt" and "boiled vegetables" for measurements. In addition, the preference sensation for the two forms at the time of measurement was investigated by free description. Results: In both types of dishes, most of the subjects had a longer residence time in the gaze point on to the nomal than the paste form. The average residence time of the gaze point was also significantly longer for the normal than for the paste form for both types of dishes. The subjects during the measurement felt that the normal food was "delicious" and "the color was beautiful", while the paste food was "I don't want to eat much" and " I don't know what kind of paste food". Conclusions: The suggestion of a relationship between the length of the line-of-sight trend and the sense of taste considered to be an index for improving the taste of swallowing food in the future.

Keyword: Swallowing food, Gaze movement

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-78)
Expressions of three α-glucosidases observed in *Tetrahymena thermophila* cultured in the medium containing different monosaccharides or disaccharides

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Background and objectives: The physiological aspects of various kinds of saccharides are yet unknown. We examined this theme by using *tetrahymena*.

Methods: 1. *Tetrahymena thermophila* were cultured in the medium containing one percent monosaccharides (glucose, fructose or galactose) or disaccharides (maltose, trehalose, sucrose or lactose). Maximum cell density was measured during steady state. 2. Enzyme activities of disaccharidases in the cytosol of *tetrahymena* cultured with various medium were assayed. 3. Total RNA were extracted from cells cultured with six kinds of medium. From those RNA, cDNA were derived by reverse transcription. With use of three primer sets, we assayed the amounts of mRNA corresponding three α-glucosidase.

Results: 1. While cell density was over 10^6 cells/ml in the culture medium including monosaccharides or maltose, it was less than that in the medium including disaccharides except maltose. In the medium including no saccharides, cell density was low also. Therefore there were observed two types of culture medium (high cell density group and low cell density group). 2.Maltase activity was the highest among disaccharidases. Though trehalase activity was the second, its activity was one sixth of maltase. Sucrase or Lactase activity were slightly observed. Maltase activities from cells of high cell density group medium were lower than those of low cell density group medium. 3. The copy numbers of threeα-glucosidase were different by the medium including different kinds of saccharides.

Conclusions: It was not found α-glucosidase gene which expressed weakly in the high cell density group medium and strongly in the low cell density group medium. But all three genes were differently expressed in the cells of different medium. It means thatα-glucosidase expression is affected by external saccharides.

Keyword: Tetrahymena, α-glucosidase, saccharides, q-PCR

PAB(T9-79)
Is anti-gliadin IgG antibody useful diagnostic biomarker for gluten sensitivity?

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Background: Gluten sensitivity is a syndrome characterized by several physical and psychological symptoms such as abdominal pain, constipation, diarrhea, headache, foggy brain, tiredness, anxiety, and depression, related to the ingestion of gluten. Although anti-gliadin IgG antibody has been presented as an immunological marker of gluten sensitivity, the diagnostic criteria have not been established yet, and much remains unclear about gluten sensitivity. Hyogo Medical University has the specialized outpatient unit for gluten sensitivity since 2019 and we have already reported the association between treatment-resistant schizophrenia and gluten sensitivity. We present finding regarding immunological gluten sensitivity in patients with subjective gluten sensitivity who visited our outpatient unit.

Method: From 2019 through 2021, patients with subjective symptoms of gluten sensitivity aged 20-70 years who visited our outpatient unit and healthy controls aged 20-70 years without subjective symptoms of gluten sensitivity were recruited. We determined immunological gluten sensitivity using anti-gliadin IgG antibody, and psychiatric and physical symptoms were evaluated by medical interview and self-administered questionnaire. We excluded participants on a strict gluten-free diet because their anti-gliadin IgG antibody levels seem to be reduced. This study was approved by the ethics committee at Hyogo Medical University. Detailed explanations of the study procedures were provided to each participant at the time we received their informed consent.

Results: The final sample consisted of 19 patients with subjective symptoms of gluten sensitivity and 173 healthy controls participated. Among 19 patients with subjective gluten sensitivity, 7 (37%) were determined as immunological gluten sensitivity. Of the 173 healthy controls, 20 (12%) were determined as immunological gluten sensitivity. As a marker of gluten sensitivity, the sensitivity and specificity of the anti-gliadin IgG antibody were 36.8% and 88.4%.

Conclusion: There is a large discrepancy between subjective and immunological gluten sensitivity. Using anti-gliadin IgG antibody solely as a biomarker are not sufficient to diagnose gluten sensitivity. Using a combination of several biomarkers is desirable to establish accurate diagnostic criteria of gluten sensitivity, and that other indicators, not only anti-gliadin IgG antibodies, are also needed. The association between the effectiveness of the gluten-free diet and changes in Anti-gliadin IgG antibodies also needs further investigation.

Keyword: Gluten, Gluten sensitivity, Non-celiac gluten sensitivity, Anti-gliadin IgG antibody, Gluten free diet

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-80)
Involvement of transcription repressor Bach1 in function of intestinal goblet cells

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Background and objectives: Intestinal mucus functions as a barrier that protects epithelial cells from harmful factors such as bacteria and virus existing in the intestinal lumen. The main component of mucus in the intestine is Mucin 2 ‹MUC2› produced by intestinal goblet cells and its proper structure such as highly O-glycosylation and disulfide band is critical for the mucus barrier. Several studies indicated that high MUC2- producing goblet cells are exposed to oxidative stress, suggesting that antioxidant pathways are important in maintaining goblet cell function. BTB domain and CNC homolog1 ‹Bach1› is a transcription repressor, which are mainly involved in the regulation of antioxidant pathway. Although Bach1 is ubiquitously expressed genes, its effect on intestinal goblet cells is still unclear. In this study, we investigated the function of Bach1 in intestinal goblet cells using Bach1-deficient mice ‹Bach1KO&rsaquo.

Methods: The colon was removed from C57BL6/J mice ‹WT› and Bach1KO, and the MUC2 expression and colonic mucus were evaluated with immunohistochemistry and Periodic acid-Schiff ‹PAS› staining. Fecal mucin contents were measured using a fecal mucin assay kit based on fluorescent labeling of GalNAc located at the reducing end. Using lectin array, we performed a comprehensive glycan profiling of fecal mucin. Furthermore, lectin blotting was performed to verify the lectins showing different profiles in WT and Bach1KO.

Results: Histochemical analyses of the colonic sections showed that MUC2-positive cells and PAS positive areas were significantly increased in Bach1KO compared to that of WT. Meanwhile, there were no difference in fecal mucin content. The results from lectin array showed that fecal mucin exhibited a significant difference in glycan profiles between WT and Bach1KO. In particular, the binding of a GalNAc-binder SBA and that of a α2-6Sia-binder SSA was increased in Bach1KO. These glycan changes were verified by lectin blotting analyses.

Conclusions: Our data indicate that Bach1 is involved in the formation of proper glycosylation of fecal mucin. The detailed molecular mechanism and effect to the secretory process of mucin is currently under analysis.

Keyword: Bach1, goblet cell, MUC2, mucin, glycosylation

PAB(T9-81)
Effect of long-term vibration stimulus on skeletal muscle mass and body composition in rats

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Background and objectives: Many studies are being conducted on the effects of nutrient intake on exercise effects such as the promotion of muscle hypertrophy, but it is not easy to make experimental animals exercise. The main method of exercise model applied to animals is forced muscle contraction by treadmill running or electrical stimulation. However, these methods have problems in that they put excessive stress on rats and cost a lot of equipment. Therefore, it is necessary to create a model that is more affordable and has a high exercise effect. In human studies, whole-body vibration stimulus by a vibration machine has been confirmed to have effects such as improvement of muscle strength and prevention of bone density decrease. However, the effects of long-term exposure to vibrational stimulus on skeletal muscle mass, body composition, and blood components have not been fully verified, and there are few studies using rats. In this study, we examined the effect of long-term vibration stimulus on rats for 12 weeks and whether vibration stimulus was appropriate as an animal exercise model.

Methods: Twenty male Wistar rats (3 weeks old) were randomized into two groups of ten rats, the control group (C) and vibration group (V), and fed with a commercial diet ad libitum for 12 weeks. Only the V group performed an exercise program using a vibration machine every day. The vibration stimulus was gradually increased from 5 min at 9 Hz to 30 min to 15 Hz. After the experimental period, all rats were sacrificed by beheading. The hind skeletal muscle, heart, liver, and abdominal adipose tissues were quickly removed and stored at −80°C until analysis. The carcass samples were stored at −20°C until analysis.

Results: The relative weights of the heart, soleus muscle, and flexor halluces longus muscle were significantly higher in the V group than in the C group. However, the weight of abdominal adipose tissues and carcass fat did not differ between the two groups.

Conclusion: These results suggest that long-term vibration stimulus may be an effective exercise program with aerobic and resistance exercise effects in rats.

Keyword: Exercise nutrition, Vibration

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-82)

Effects of Remote Assistance-focused Resistance Exercise and Nutritional Guidance on Body Composition, Muscle Strength, and Physical Function in Community-dwelling Japanese Older Adults

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Background and Objective: To clarify whether long-term implementation of a frailty and sarcopenia prevention program using a remote assistance-focused method is as effective as a face-to-face program in community-dwelling Japanese older adults.

Methods: Forty-nine community-dwelling older adults (16 males, 33 females, age: 70.0 ± 4.8 years) were randomly classified into the following three groups: face-to-face guidance group (FGG; n=17), remote guidance group (RGG; n=17), and control group (CG; n=15). Adults in the FGG performed 60 minutes face-to-face supervised resistance exercise once a week for the first 4 weeks plus similar exercise once a week at home, followed by 8 weeks of no face-to-face instruction and performed the same exercises twice a week at home while watching an instructional medium (DVD) for a total of 12 weeks. Nutritional guidance was provided once in person, followed by guidance over the telephone once a month, for a total of three sessions. Adults in the RGG performed the same exercises at home while watching an DVD twice a week and were provided nutritional guidance over the telephone once a month for a total of three times for 12 weeks. Body composition, muscle strength, and physical functions, such as five times sit-to-stand test, were examined before and after intervention. Adults in the CG were only examined before and after intervention and did not undergo any intervention.

Result: Lean body mass, muscle mass, lower limb muscle mass, appendicular skeletal muscle mass, skeletal muscle index (SMI), and grip strength increased significantly, and the body fat percentage decreased significantly in the FGG compared to pre-intervention measurements ($p < 0.05$). In the RGG, only grip strength increased significantly ($p < 0.05$). However, there was all no significant difference in the rate of change among the three groups. In the female-only sub analysis (FGGf; n=12, RGGf; n=12, CGf; n=9), SMI and grip strength increased significantly compared to pre-intervention measurements, and the rate of change was significantly different between the FGGf and CGf groups ($p < 0.05$).

Conclusion: These 12-week combined interventions may help improve muscle mass and muscle strength in older adults. However, a remote guidance program may be maintain them but challenging to improve.

Keyword: Sarcopenia, Frailty, remote guidance, Physical exercise and Nutritional intervention, COVID-19 pandemic

PAB(T9-83)

A Data science approach to develop growth cut-offs for graded care of malnutrition

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Background: The recommended classification of malnutrition by the World health organization (WHO) is based on cut-offs derived from the standard distribution of anthropometric measurements. These cut-offs are used to study the relationship between physical growth and childhood outcomes like death and morbidity. Since treatment decisions are taken based on these cut-offs, developing a new cut-off based on the risk of death as an outcome associated with anthropometric indicators will be a significant improvement on current distributional-based cut-offs.

Methods: Pooled data from 4 interventional and non-interventional studies across India were used for the analysis. Anthropometric measurements as well morbidity information of children less than 2 years was used for the analysis. A Bayesian hierarchical generalized additive model has been used to find the association of WAZ (Weight for age Z score) with a latent risk of death derived from the morbidities experienced by the child with the assumption that the association changes for different risk groups by Bayesian IRT. Cut-offs for both male and female groups in each malnutrition category were identified using segmented regression analysis.

Results: A non-linear decreasing relationship exists between WAZ with risk of death in children. Compared to males, a lesser risk of death has been found for females. Four cut-offs were identified for both males and females. Cut-offs for males were identified at -3.27(-3.29, -3.24), 0.012(-0.01,0.04), 1.64(1.6,1.69), 3.25(3.03,3.47) and -3.39(-3.41,-3.37), -0.01(-.05,0.014), 1.56(1.51,1.61), 3.13(2.90,3.35) for females.

Conclusions: A finer categorization of malnutrition based on the risk of death can be used to develop and then deliver tailored optimized therapeutic options for what is essentially a far more eclectic group than what is captured by a current classification of undernutrition.

Keyword: Growth Cut-offs , Malnutrition, Z scores

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786

PAB(T9-84)

Designing a new Nutrient Profiling model to quantify the Nutritional Footprint of seafood products: Nutrient Rich Food 12.2 index

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Background and objectives: The water-energy-food nexus (WEF) approach has been promoted as a powerful tool to assess environmental impacts, and to highlight and enhance synergies between the three pillars involved, thus ensuring better resource management, and contributing to the achievement of the Sustainable Development Goals. Nutrient profiling (NP) models allow food to be classified and diets to be assessed according to their nutritional quality. Among them, the Nutrient Rich Food (NRF) indexes, which combine both nutrients to promote and nutrients to limit, have been proposed as potential indicators in the nutritional footprint to be integrated in the WEF nexus. Recent research has revealed that NRF9.3 index is the one that correlates the best with the health-related nutritional impacts of products.

Methodology: For the assessment of nutritional footprint of seafood products, we aim to develop a new index by redesigning the NRF9.3, as it does not consider certain nutrients for which fish stands out for having high contents. The modified version of NRF9.3 is the specific seafood model NRF12.2, in which a macronutrient (fibre) and one nutrient to be limited (added sugar) are excluded because they are absent in this type of food. On the other hand, one fatty acid -docosahexaenoic acid (omega-3)- and two minerals -iodine and selenium-, are considered since seafood products are important sources of these nutrients in diets. Therefore, the NRF12.2 is based on twelve nutrients to encourage and two nutrients to be limited per reference amounts customarily consumed (RACC).

Results: When the seafood product assessed is a processed product composed by different ingredients, such as those typical added in the processing (e.g., olive oil), it is necessary to adapt the NRF index to each case study. We propose the use of weighting factors based on the proportion in which each ingredient is found in the final product.

Conclusions: The main outcomes prove that the new index specially designed for seafood products offers a complete and robust characterisation of their nutritional impact. The NRF12.2 model allows the study of the best choices of products to include in nutritious and balanced diets, also ensuring through the WEF nexus approach, that they are environmentally sustainable.

Keyword: nutrient rich food model, water-energy-food nexus, sustainable diet

Ann Nutr Metab 2023;79(suppl 1):14–1172
DOI: 10.1159/000530786